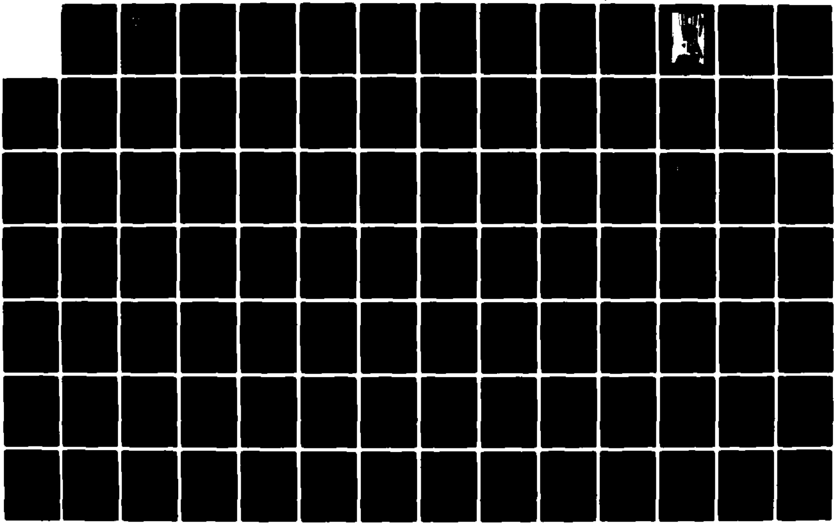
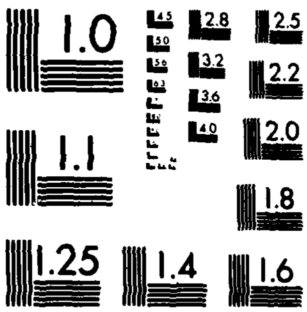
AD-A121 580 VEHICLE NOISE MEASUREMENTS(U) ARMY ELECTRONIC PROVING GROUND FORT HUACHUCA AZ APR 80 USAEPG-FR-1065-3 1/3

UNCLASSIFIED F/G 20/1 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(2)

AD A121580

TECOM PROJECT NO. 6-CO-242-ESS-109

PUBLICATION NO. USAEPG-FR-1065-3

TEST SPONSOR: USACEEIA

FINAL REPORT

VEHICLE NOISE MEASUREMENTS

APRIL 1980

U.S. ARMY ELECTRONIC PROVING GROUND
Fort Huachuca, Arizona

FOREWORD

Bell Technical Operations Textron, Tucson, Arizona, assisted in the preparation of this report under contract DAEA18-76-C-0002. The consultant services of Dr. A. D. Spaulding of the Office of Telecommunications, U. S. Department of Commerce, and Mr. George Hagn from SRI International, were used in the planning, execution, data analysis, and report preparation phases of this task. Contributions were also made by Mr. R. Southwick and Dr. A. Perkins, who represented the sponsor, USACEEIA.

Form 50 on file

A

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

Page

LIST OF ILLUSTRATIONS (CONT)

Figure

LIST OF TABLES

SECTION 1 - INTRODUCTION

1.1 BACKGROUND OF PROBLEM

a. Communication systems operating in the electromagnetic (EM) environment are subject to EM disturbances, which affect the reception of information. These EM disturbances, termed environmental noise, are grouped into three broad categories: galactic noise, atmospheric noise, and man-made noise. In recognition of the need for work in the area of vehicle ignition noise and its effects on communication system performance (ref 11), the United States Army Communication-Electronic Engineering Installation Agency (USACEEIA) tasked the U.S. Army Test and Evaluation Command (TECOM) with establishing a test program to determine the EM emissions from military and civilian vehicles powered by gasoline-fueled, internal-combustion engines.

b. On 15 August 1978, TECOM tasked the U.S. Army Electronic Proving Ground to measure the EM noise emissions from vehicles with gasoline internal-combustion engines and to evaluate the performance of various tactical communication systems deployed in the proximity of such vehicles.

c. The overall objectives of this test program were to measure the statistical structure of the ignition noise generated by EM emissions of single- and multiple-vehicle configurations and to determine the cause/effect relationship of such emissions on various communication systems. The specific goals (all of which were met) were to--

(1) Prepare vehicular noise measurement and communication system performance test methodologies. (Test methodologies were developed and are presented in the test plan, app 4, ref 12.)

(2) Measure the statistical structure of vehicular noise. (Results of measuring vehicular noise are presented in para 2.2.)

(3) Analyze single- and multiple-vehicle noise data to determine their distributions with associated means (μ), variances (σ^2), and confidence limits. (Results of this analysis are presented in paras 2.3 and 3.1.)

(4) Analyze the relationships between the statistical structures of single- and multiple-vehicle noise. (Results of this analysis are presented in paras 2.3 and 3.1.)

(5) Analyze the relationship between the statistical structure of multiple-vehicle noise data and the communication system performance data. (Results of this analysis are presented in paras 2.3 and 3.1)

(6) Provide recommendations and propose methodologies for future data measurements and analyses. (Recommendations and prepared methodologies are presented in para 1.3.)

1.2 SOLUTION TO THE PROBLEM

a. This effort was directed towards the study of vehicular noise and its effects on communication system performance. To conduct this study, a program

was established which encompassed investigative tests on vehicles in single- and multiple-vehicle configurations in an open-field site. The vehicles described in appendix 1 were acquired for these tests. A mobile van instrumented with special-purpose test equipment was used to collect (see app 2 for measurement techniques) and process the measured noise data. Appendix 3 presents samples of measured data. These data were then further analyzed with the use of a computer to provide estimates of the cumulative distribution for the envelope of the noise in addition to determining the relationships between the appropriate statistical parameters of vehicle ignition noise.

b. In addition, a limited number of communication performance tests were conducted on U.S. Army communication systems (see app 1 for description) while the receivers were exposed to vehicle ignition noise emissions. The results of these tests were used to provide values of articulation score (AS), as determined by a panel of trained listeners, and articulation index (AI), as determined by the Voice Interference Analysis System (VIAS), for each system under various vehicular noise conditions. Appendix 2 presents detailed descriptions of AS and AI and associated measurement techniques. The AS and AI data were then analyzed to identify their relationship to the vehicle noise emission data.

1.3 MAJOR RESULTS AND RECOMMENDATIONS

1.3.1 Major Results

a. For the four communication systems investigated, a relationship has been found between AS and AI for impulsive noise (see fig. 17). This relationship is quite similar to that found for other forms of interference; for example, Gaussian noise (see fig. 18).

b. For the amplitude-modulated (AM) system operating in an impulsive ignition noise environment, intelligibility can be maintained at significantly lower signal-to-noise ratios than those required for the ambient Gaussian noise (see fig. 15). This corresponds to the findings of previous test results for impulsive noise (see fig. 4.13 in Spaulding, ref 1).

c. The results for the frequency-modulated (FM) system appear to be similar to those found for the AM system in item b above (see fig. 14). The comparison, however, is not as dramatic and is more varied.

d. For the high-frequency single sideband (HF SSB) system, the ambient interference consisted of primarily continuous wave (CW), which was much less degrading than the impulsive ignition noise (see fig. 13). The degradation in this case seemed to be relatively independent of the number of vehicles present.

e. The results for the FM/PCM (pulse-code-modulated) system indicate that the system is impervious to ignition noise in that very high intelligibility was maintained in all cases until synchronization was lost (see fig. 16).

f. A significant data base of ignition noise amplitude probability distribution (APD) and average crossing rate (ACR) (see table I, refs 1 and 2, and appendix 5) measurements was attained and documented.

g. APD measurements (see table I and app 5) are useful for separating the root-mean-square (rms) vehicular (V_v) and ambient components of the composite noise signal (see app 3) present in the intermediate frequency (IF) bandpass of a receiver. However, cases were observed particularly at lower frequencies, where the ambient was so dominant that an estimate of the vehicular component was difficult.

h. At the two lower frequencies, 23 and 75 MHz, the ambient background was quite variable and generally composed of interfering signals, rather than the normally assumed Gaussian background.

i. The vehicular rms component (V_v) varies approximately as 10 log b, and the peak envelope voltage (V_p) varies approximately as 20 log b, where b is the bandwidth. The ambient rms component (V_a) may or may not vary as 10 log b, depending on the nature of the ambient interference. The average envelope value (V_{av}) and the root-mean-square envelope value (V_{rms}) were both highly correlated with V_a (i.e., r = 0.996 and 0.901, respectively) and tend to vary with bandwidth in much the same way as V_a (ref 1).

j. The structural moments of vehicular noise (V_{rms} and V_{av}) taken at one frequency cannot, with much accuracy, be extrapolated to other frequencies. Similarly, the APD's cannot be accurately extrapolated to other frequencies and/or bandwidths.

k. A reasonably simple technique has been developed for estimating the multiple-vehicle APD's from the APD's of the individual contributing vehicles (see app 3).

1.3.2 Recommendations

a. In future tests, it would be desirable to measure the APD at the IF output of the communications receiver. These measurements should be compared with the APD's recorded by the test measurement system.

b. The noise automatic test equipment (NATE) system should be compared with other APD measurement systems for various types of noise conditions.

c. In future tests, a wide range of signal-to-noise ratios should be used to estimate the AS/AI performance characteristics.

d. Recommendations are made for further statistical analysis of the measured data and the establishment of a measurement program to evaluate the effect of vehicular noise on radios using new techniques for data transmission (SINCGARS-V), PLRS, etc.).

e. A review of the data on some of the systems tested suggests that further measurements are desirable for these types of systems.

f. Modifications should be made to the amplitude probability detector to use an estimator scheme to select amplitude levels and to change the dwell time at each probability to assure equal statistical confidence for each data point.

1.4 ORGANIZATION OF THE REPORT

This report is divided into two major parts, the first of which, designated sections 1 through 4, includes the summary of methodology, summary of results, conclusions, recommendations, and a list of the references. The second major part, consisting of appendixes 1 through 5, presents detailed test and analysis information (including descriptions of the vehicles and communication systems), description of measurement instrumentation, data analysis and results, raw data, and glossary of symbols. Because of the volume of the directly measured data, appendix 5 has not been published; but the raw data can be made available to those who need to see them.

SECTION 2 - SUMMARY OF METHODOLOGY

2.1 INSTRUMENTATION

2.1.1 General

a. Noise parameter data were collected for vehicle EM emissions according to the test plan (ref 12) by a special computer-controlled receiving and data reduction system. This system, known as the noise automatic test equipment (NATE), is shown in figure 1. The NATE system, except for its receiver, was installed in the shielded portion of a mobile van. The receiver/selector components were located at the base of the antenna. NATE system automatically stepped through a prearranged sequence of test instructions to collect and compile vehicular noise parameter data. These data were then stored for data reduction and printout. As depicted in figure 2, the components of NATE are the antenna, receiver/preselector, programmable spectrum analyzer, amplitude probability detector, programmable computer interface, desk top computer, and peripherals. Electromagnetic emanations were intercepted by the antenna, and the resulting analog signal was then fed to the receiver/preselector. Here, the signal was filtered, amplified, and mixed with a stable sinusoidal signal supplied by the programmable local oscillator. The resulting signal had a 1-MHz bandwidth and was centered at 21.4 MHz. This signal was then supplied to the radio frequency (RF) input of the programmable spectrum analyzer, which was tuned to 21.4 MHz. The analyzer was operated as a receiver/detector (i.e., in the time domain) and was set in the logarithmic ($\log_{10}$) output signal mode to increase the test system's dynamic range. The analyzer detected the input signal in accordance with computer-selected parameters. The output video signal, representing the voltage envelope of the noise emanation with a specific bandwidth, was fed from the analyzer to the amplitude probability detector. The detector measured ten points on APD and ACR functions for the noise, in addition to the envelope voltage rms (V_{rms}) and average (V_{av}) values. Peak voltage (V_p) was measured by the HP-8568A spectrum analyzer. The APD, ACR, V_{rms}, V_{av}, and V_p values were sent to the HP-9845 desk-top computer for analysis, storage, and display.

b. Automatic instrument control and data logging were incorporated into the system. The controller was an HP-9845, which interfaced through both an IEEE-488 bus and a CDC 53 interface. The CDC 53 provided an extended interface for the IEEE-488 bus as well as the ability to listen to other types of input signals and to permit control by means of the bus over certain other equipments, such as relays and attenuators. By using this configuration, the amplitude probability detector, filters, amplifiers, local oscillator, and spectrum analyzer were controlled by the HP-9845.

c. Software was written to generate a sequence of (measurement) events plus prompting. Prompting was used to allow the test personnel to make certain manual checks and adjustments required during the measurement sequence.

d. All data and measurement system parameters were entered into the HP-9845 either automatically by magnetic tape or manually through the console by the test personnel. The collected data were recorded on data sheets or graphs, which were generated by subroutines contained within the overall

(Text continued on page 2-4)

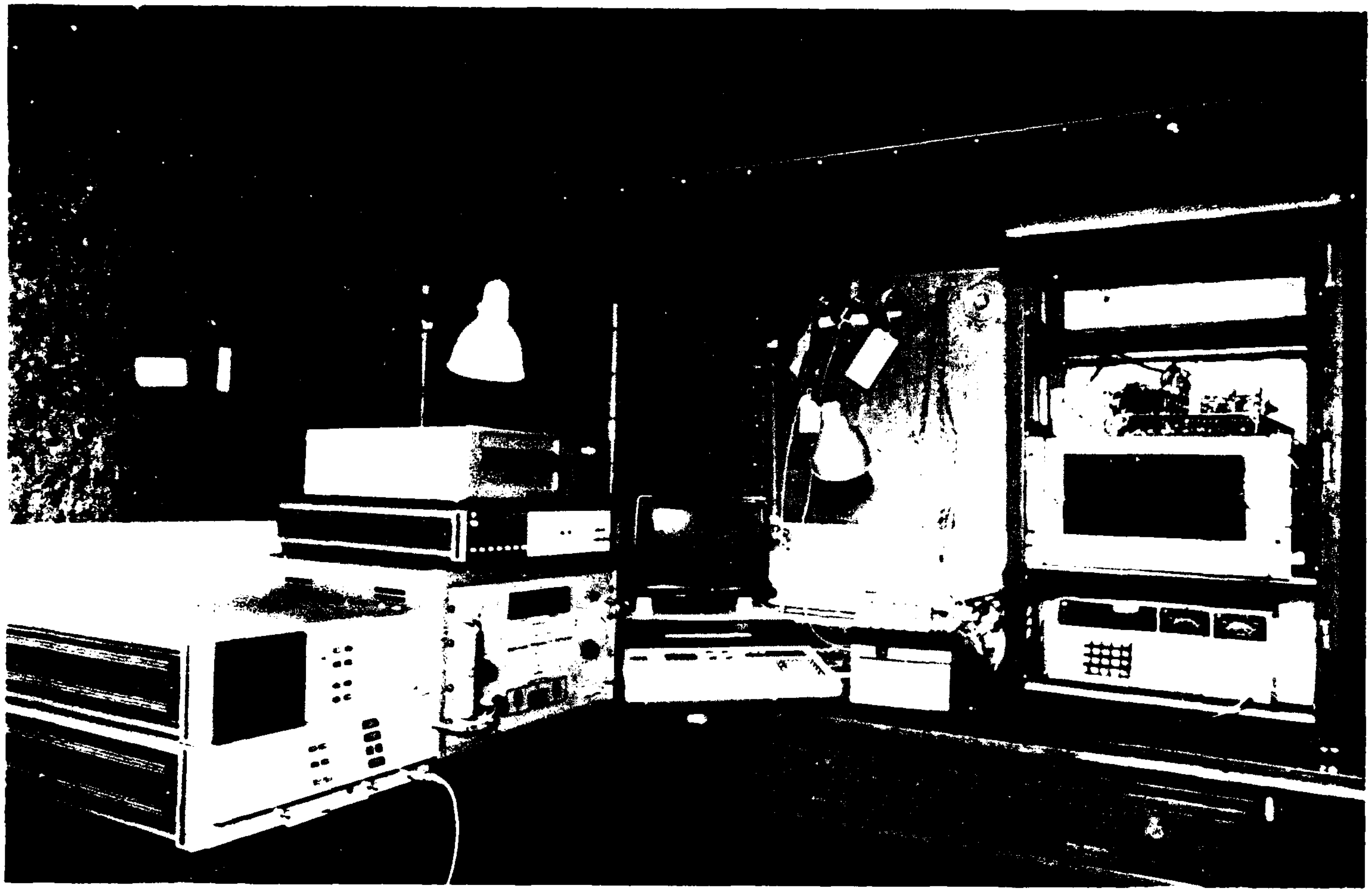
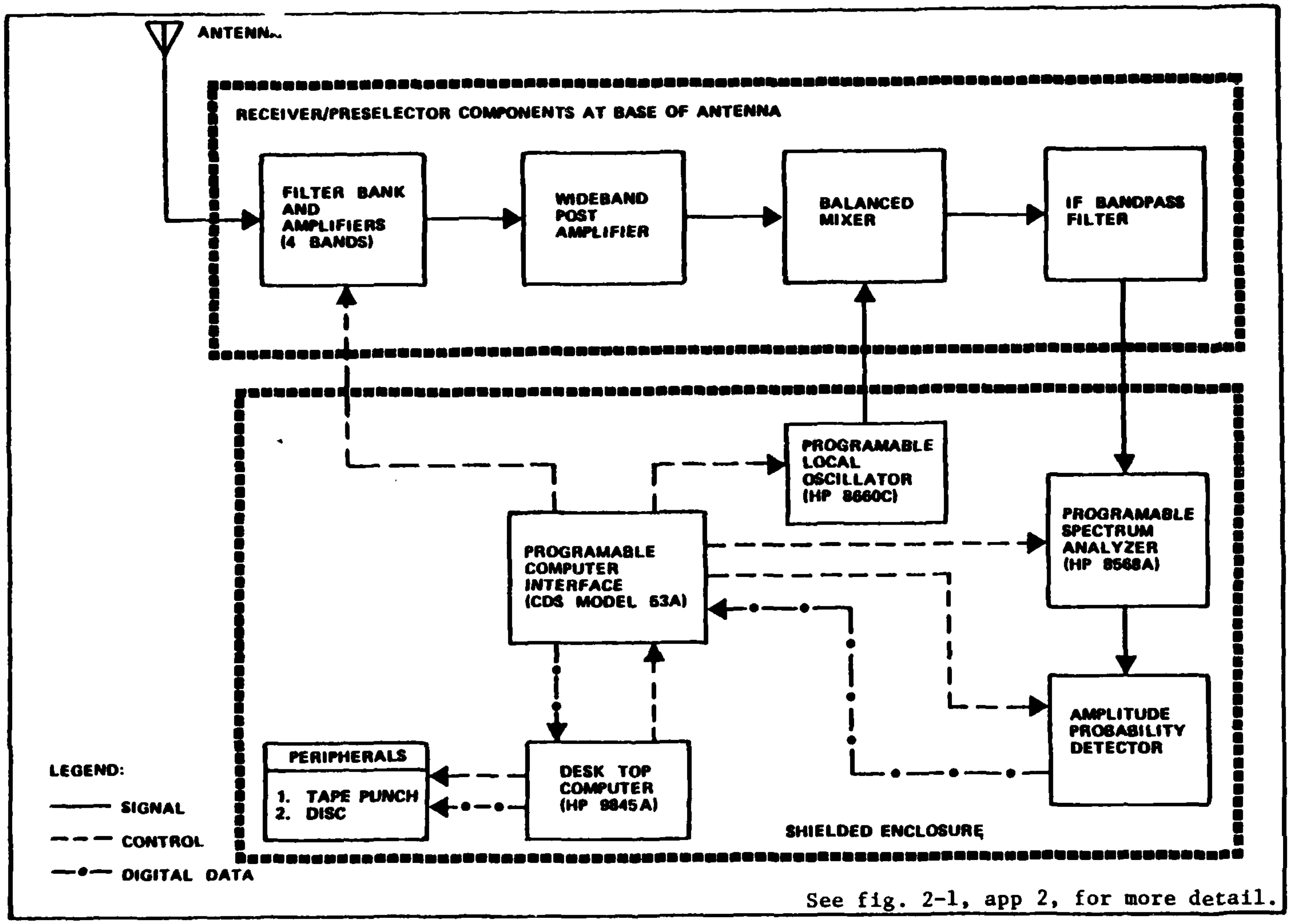


Figure 1. Interior view of shielded enclosure portion of NATE van.



See fig. 2-1, app 2, for more detail.

Figure 2. Noise automatic test equipment block diagram.

automatic test sequence (ATS) program. In addition, the data were then recorded on paper tape for future analysis.

2.1.2 Single-Vehicle EM Noise Emission Tests

a. EM noise emission tests were performed on a number of single vehicles to obtain data on the statistical structure of noise generated by their ignition systems, which would provide a basis for a detailed analysis.

b. The NATE system and test antenna were set up as shown in figure 3 for the single-vehicle tests. Prior to the vehicle noise runs, the NATE was calibrated by means of the methodology described in appendix 2. In addition, system and ambient noise data were collected before each vehicle noise run. Depending on the operational frequency, a calibrated biconical or coplanar log periodic antenna was positioned in front of the vehicle at an antenna aspect angle of zero degrees.

c. Tests were conducted on each of the 12 vehicles, positioned as shown in figure 3, and data were collected on the noise parameters described in table I for spectrum analyzer bandwidths and receiver tuned frequencies listed in table II. The vehicle was usually positioned three meters from the test antenna, or as noted on the test data sheets. Measurements were performed on each of the vehicles with the engine rotational speeds set at 1500±30 r/min. In addition to the data shown on the data sheets, the peak voltage, V_p, was measured manually with a field intensity meter (EMC-25) and appropriate antenna at the side of the vehicle, according to SAE J551e (ref 2) for all four test frequencies, and for 50 and 153 MHz--for the purpose of possible comparison with the NATE data and data taken in other SAE tests (ref 3). The EMC-25 antenna was positioned at the side of the vehicle (per ref 2), and the data were taken simultaneously with those of the NATE.

d. Tests were also conducted (set up as in fig. 3) to determine the variations in ignition system noise produced by a single vehicle as a function of vehicle distance from the test antenna. Noise parameter data described in table I were collected using the spectrum analyzer bandwidth of 300 kHz and the receiver tuned frequencies shown in table II. The vehicle was positioned at 2, 5, 10, 20, 50, and 100 meters from the test antenna. These measurements were conducted on 4 vehicles. Three whose noise emissions were the greatest were selected from the first 12. One of these was the vehicle tested for ignition noise emission previously on the "Wheels" task (refs 4 and 5). The fourth vehicle tested (number 13) was not of the group of 12 but was a particularly noisy one used for transportation by one member of the test personnel. For each test, the engine rotational speed was set to 1500±30 r/min.

2.1.3 Multiple-Vehicle EM Noise Emission and Communication System Performance Tests

a. EM noise emission tests were performed on multiple vehicles to obtain data on the statistical nature of the noise generated by their ignition systems. Communication system performance in the presence of this noise was also measured. The data obtained provided a basis for further analysis.

(Text continued on page 2-8)

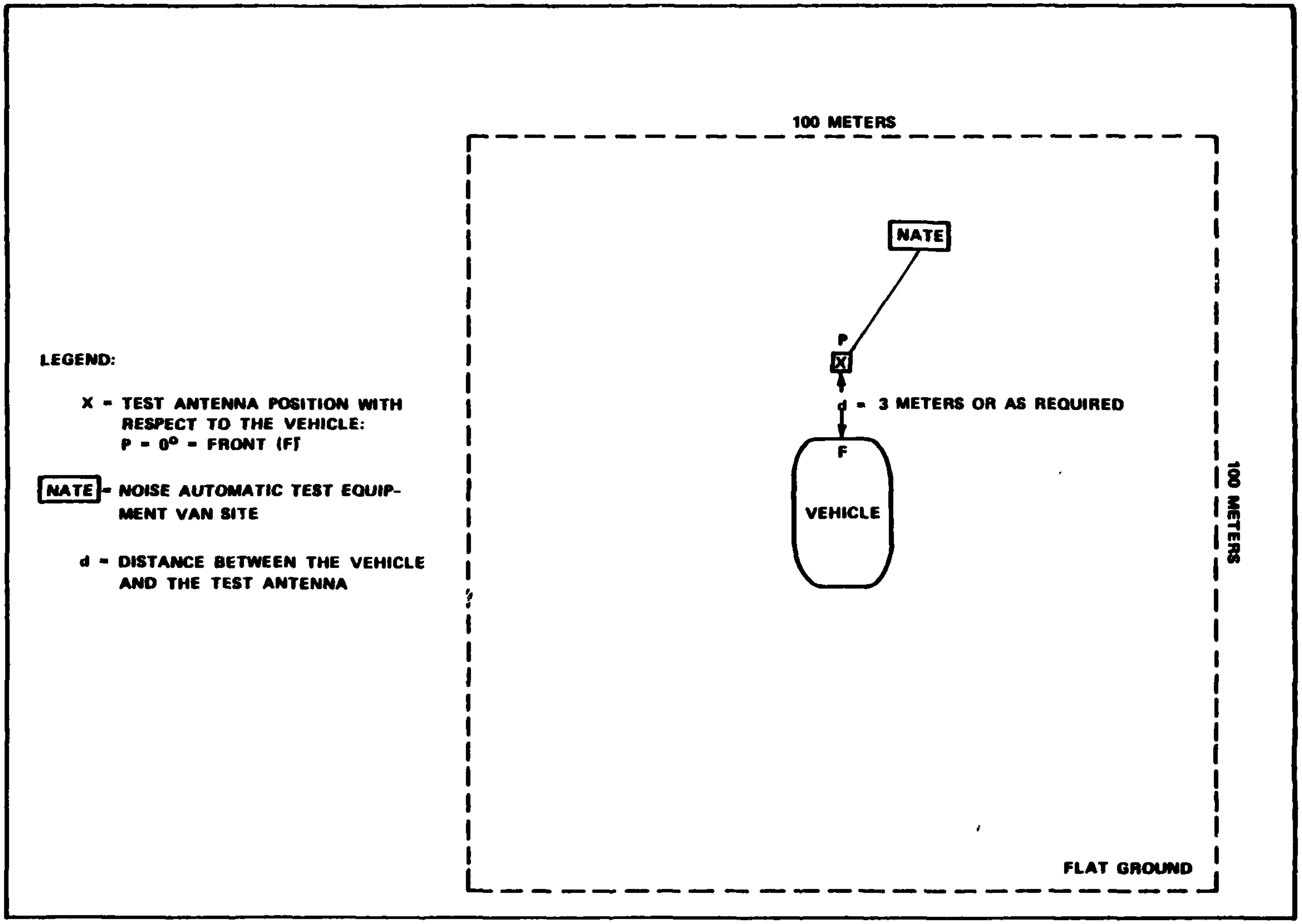


Figure 3. Plan view for the conduct of single-vehicle noise tests.

TABLE I. VEHICLE NOISE PARAMETERS

Parameter	Definition*	Mathematical relation*
Amplitude probability distribution (APD)	The probability that for interval T the voltage v(t) exceeds a specified limit, v_i, where v(t) is the envelope at IF output	$\text{Prob}\,[v \geq v_i] = 1 - \text{Prob}\,[v < v_i]$ $\text{Prob}\,[v \geq v_i] = 1 - \int_0^{v_i} p(v)\,dv$
Average crossing rate (ACR) characteristic	Number of positive threshold crossings per second versus threshold level for the interval T	$C(v_i) = \frac{1}{2}\int_{-\infty}^{\infty} \dot{v}\; p(v_i, \dot{v})\,d\dot{v}$
Noise power (P_N)	The mean noise power available from a loss-free antenna due to an external source, determined over an interval T	$P_N = f_a kT_0 b = (T_a/T_0)\,kT_0 b$ $F_a = 10 \log f_a$ $k = 1.38 \times 10^{-23}$ joules/degree K $T_0 = 290°$ K b = effective receiver noise bandwidth (Hz) T_a = effective antenna temperature in the presence of external noise f_a = effective antenna noise factor $V_{rms}^2 = \frac{1}{T}\int_0^T v^2(t)\,dt = \int_0^{\infty} v^2 p(v)\,dv$ Y = admittance function $P_{NIF} = 0.5 \cdot V_{rms}^2 \cdot \text{Re}[Y]$ at IF output $P_N = P_{NIF}/G_r$ where G_r is receiver gain
Peak voltage (V_p)	Measured peak voltage value of v(t) over the interval T	Value of V_p is highly dependent on the interval T
Average voltage (V_{av})	Measured average voltage value of v(t) over the interval T	$V_{av} = \frac{1}{T}\int_0^T v(t)\,dt = \int_0^{\infty} vp(v)\,dv$
Average voltage deviation (V_d)	The dB difference between V_{rms} and V_{av}	$V_d = 20 \log \frac{V_{rms}}{V_{av}}$ V_{rms} = root-mean-square voltage

*Assumes stationarity over interval T

TABLE II. TEST CONFIGURATION REQUIREMENTS FOR THE MEASUREMENT OF VEHICULAR NOISE AND COMMUNICATION SYSTEM PERFORMANCE PARAMETERS

Vehicle	Vehicle Type	f (MHz)	BW (kHz)	s (r/min)	P (degrees)	d (m)	n
Civilian	Passenger (4,6,8 cylinder)	23	3, 10, 30	1500 ±30	0	as required	12
		75	3, 10, 30, 100, 300				
		300	10, 30, 100, 300				
		900	100, 300				

f = RF test receiver frequency
BW = Spectrum analyzer bandwidth
s = Engine rotational speed
P = Test antenna position with respect to vehicle
d = Test antenna distance from vehicle
n = Number of vehicles

b. For the multiple-vehicle and communication performance measurements, the NATE system and test antenna were arranged as shown in figure 4. As in the previous tests for single vehicles, NATE was calibrated by the methodology of appendix 2. In addition, system and ambient noise data were collected prior to starting each subtest. For these tests, the vehicles were placed on a three-meter radius about the test antenna, with the front of the vehicles toward the antenna.

c. The communication system equipment was installed in a separate van in the configuration shown in figure 5. This equipment was operated at the following frequencies:

Equipment	Frequency (MHz)	Nominal IF Bandwidth (kHz)
AN/GRC-106	23	10
AN/VRC-12	75	30
AN/ARC-51	300	30
AN/GRC-103	900	300

d. Data were collected on the noise parameters described in table I using the spectrum analyzer bandwidths and receiver tuned frequencies listed in table II. The engine rotational speed of each vehicle was set to 1500±30 r/min.

e. Communication link tests with vehicle noise as an interfering source were performed for the vehicle configurations marked yes in the right-hand column of table III. For these tests, three levels of degradation were recorded by adjusting the transmitter signal level into the communication receiver. The signal level into the receiver was then measured and entered on a data sheet. In one test sequence (number 29), the signal level was held fixed while three levels of degradation were obtained by adjusting the noise level.

f. At each of the three levels of degradation, a phonetically balanced word group was transmitted over the communication link. The audio output of the receiver was recorded for evaluation by trained listeners to obtain AS. The VIAS was used to measure AI for each degradation level.

2.2 DATA COLLECTED

a. Measured data results of the various vehicle noise tests are contained in appendix 5 of this report. The test was conducted during the period 13 to 24 August 1979 at a low-noise site. The site was selected based on spectral data collected as part of the site selection process (ref 13).

b. Approximately 1700 amplitude probability detector scans were made during this time frame, which resulted in 420 automatically recorded and printed data graphs. Each graph contains results from four scans: (1) a scan using a calibrated noise source (see fig. 2, app 2), (2) a total system noise scan, (3) an ambient noise scan, and (4) the test vehicle noise scan. The 420 data graphs are for various single- and multiple-vehicle tests configured from 13 test vehicles, which consisted of (1) a noisy 8-cylinder 1970 Chevrolet truck,

(Text continued on page 2-12)

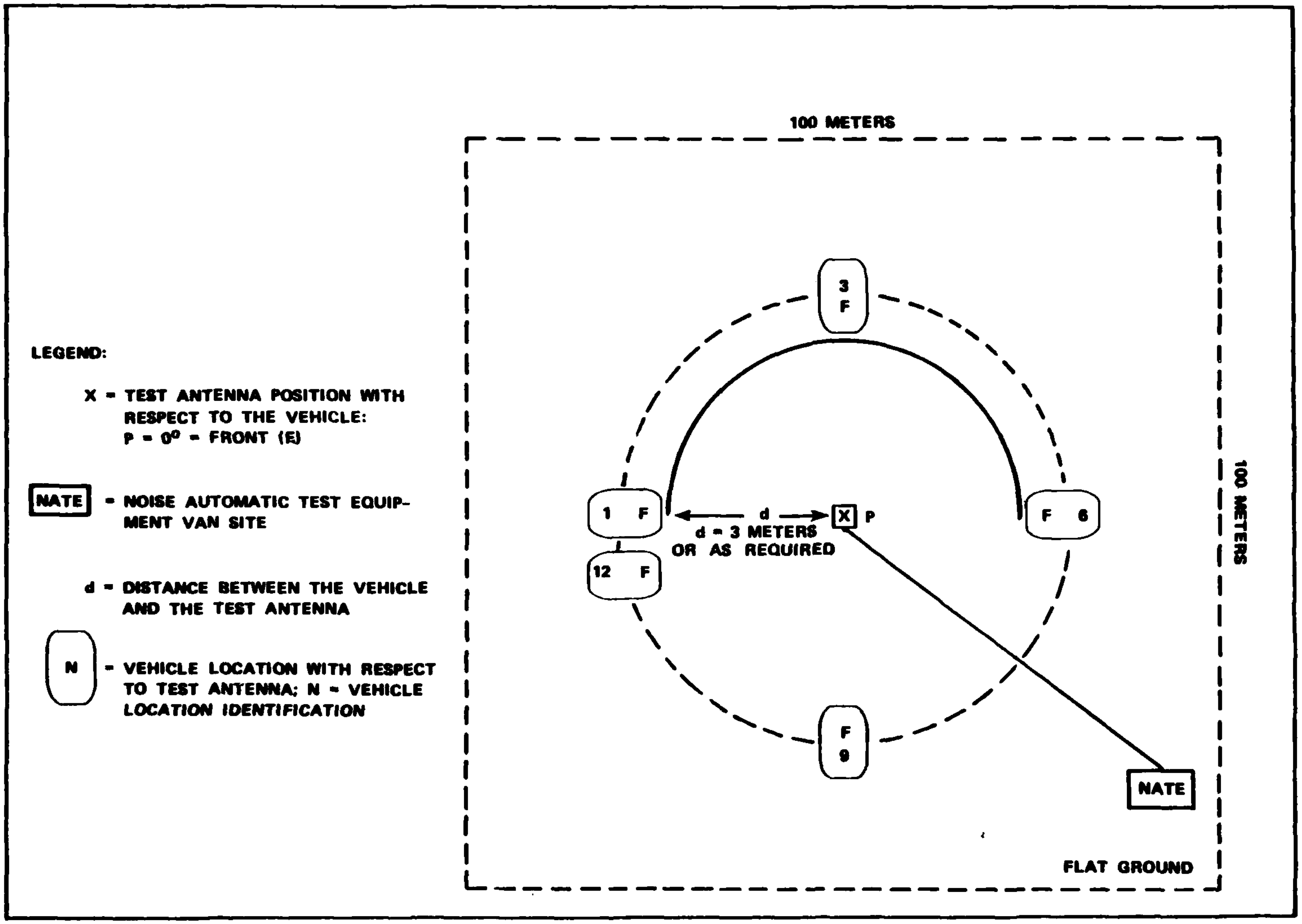


Figure 4. Plan view for the conduct of multiple-vehicle noise tests.

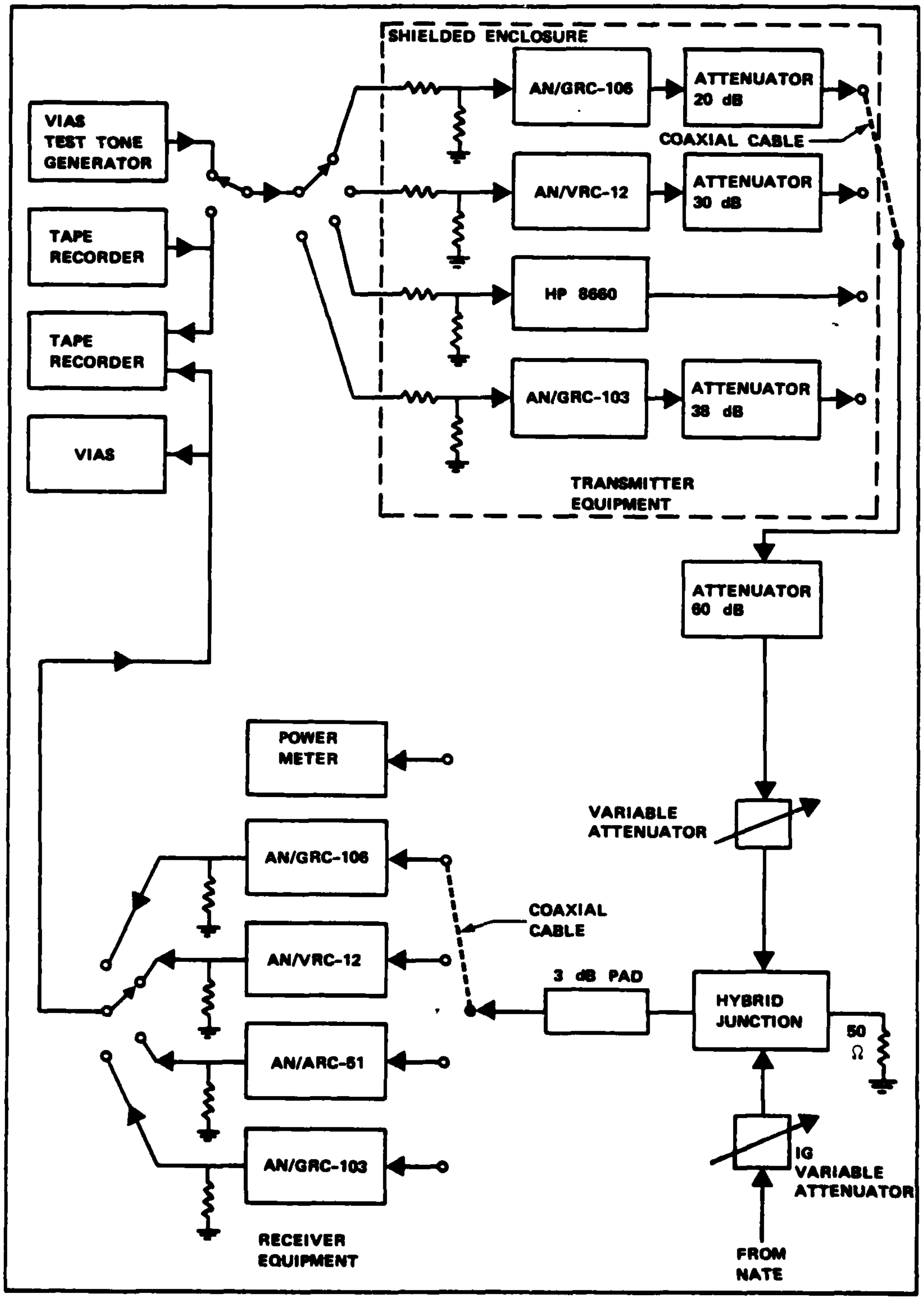


Figure 5. Communication system block diagram.

TABLE III. VEHICLE CONFIGURATION TEST CODES

Test Code	No. of Vehicles Tested	AI and AS
1	1	No
2	1	No
3	1	No
4	1	No
5	1	No
6	1	No
7	1	No
8	1	No
9	1	No
10	1	No
11	1	No
12	1	No
13	3	No
15	1	Yes
16	12	Yes
17	6	Yes
18	6	No
19	6	No
20	3	No
21	3	Yes
22	3	No
23	2	No
24	2	No
29	1	Yes
30	0	Yes

NOTE: Test codes 29 and 30 correspond to the results for tests 25 and 14, respectively. They were rearranged for convenience.

(2) an 8-cylinder 1970 Dodge pickup (one of the original "Wheels" vehicles, ref 3), (3) two 8-cylinder 1973 Ambassadors, (4) five 6-cylinder 1979 Fords, (5) one 6-cylinder 1974 station wagon, and (6) three 4-cylinder Fords.

c. Four different communication links were set up. Various configurations of vehicle types were used as noise sources to interfere with the links.

d. The key noise parameters which were used to provide a statistical analysis of vehicle noise and communication system performance are: (1) APD, (2) ACR, (3) P_N, (4) V_p, (5) V_{av}, (6) V_{rms}, and (7) average voltage deviation (V_d). The noise parameter data (table I) were stored on paper tape for future analysis and quick retrieval. In addition, hardcopy printouts of the data similar to figure 6 were recorded. A total of 419 data printouts were provided by the measurement schedule. Table IV presents a summary of the annotations found on the hardcopy printouts.

e. A limited number of communication performance tests were conducted on U.S. Army communications systems while the communication links were exposed to vehicle ignition noise emissions. During these tests, recordings of the receiver audio output were made to determine AS. A total of 15 tapes (60 word groups) was provided for articulation scoring.

2.3 BRIEF DESCRIPTION OF ANALYSIS METHODS

2.3.1 Single-Vehicle Tests

a. APD Data and Plots

(1) The APD raw test data, in terms of voltage threshold as a function of probability (see fig. 6), were grouped and analyzed with the aid of software developed for a PDP 11/45 computer. Certain portions of these data were eliminated from the analysis. These were cases where errors were noted and in which the ambient noise (i.e., receiver noise plus interference with the vehicle off) was dominant and no reasonable estimate of the vehicular noise component could be attempted. It was assumed, based on previous results (ref 6), that the APD for vehicular noise was a composite Weibull distribution defined for ambient and vehicular noise regions.

(2) This report presents parameter values such as V_{rms}, V_a, and V_v, all of which are measured for specific bandwidths, b. These values refer to the mean square values of the IF envelope voltage, that is, $E(v^2)$, where $E(\cdot)$ denotes the probabilistic expected value. In particular, V_{rms} refers to the rms value of the IF envelope when both the vehicular and ambient noise components are present. V_a and V_v represent the rms values of the ambient and vehicular noise components, respectively. The IF voltage can be written as:

$$v_{IF}(t) = r_a(t)\cos[\omega t + \phi_a(t)] + r_v(t)\cos[\omega t + \phi_v(t)]$$

$$v_{IF}(t) = v(t)\cos[\omega t + \theta(t)]$$

(Text continued on page 2-15)

VEHICLE NOISE TEST
5

TEST SETUP DATA:

08/21/79 (M/D/Y)
19:25:01 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON TYPE 407

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	100E-01	27.3
2	.0005	400E-01	23.3
3	.0010	820E-01	21.3
4	.0100	498E+00	12.4
5	.0200	798E+00	7.5
6	.0500	157E+01	.5
7	.1000	310E+01	-7.4
8	.2000	598E+01	-12.3
9	.3000	906E+01	-14.3
10	.4000	101E+02	-15.3

Cal. RMS	Va g	Vd	Vp	Noise F.
52.6dBuV	37.7dBuV	9.1dB	72.0dBuV	-63.1dBm

$\hat{V}_v = 46.3$ dB(μV) $\hat{V}_a = 32.4$ dB(μV)

$V_{amb} = 30.0$ dB(μV)

$\Omega_{2B}^{(G)} \doteq 25.7$ dB(μV)

RMS level compares to 29.32 dB above KTo = 46.39 dBuV across 50ohms

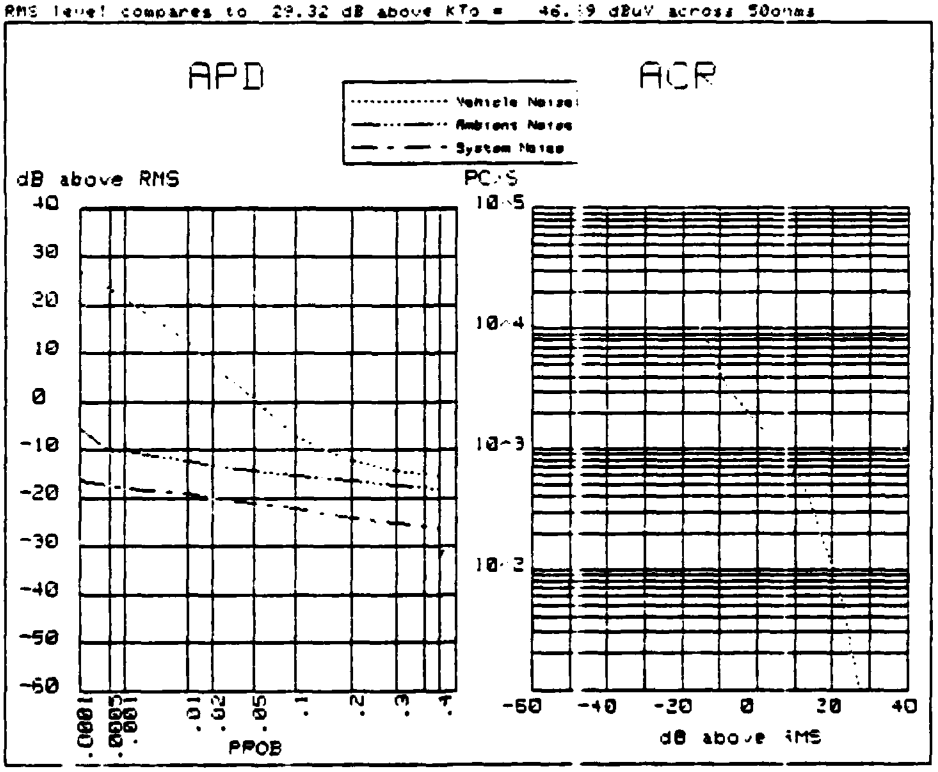


Figure 6. Example of data for a selected test.

TABLE IV. SUMMARY OF HARD COPY PRINTOUT DESCRIPTORS

Item	Description
The selected vehicles for test code ( ) are number(s):	
Vehicle noise test	Data sheet identifier.
(M/D/Y)	Month/day/year for test.
(H:M:S)	Hour: minute: second for test.
Test setup data:	
Vehicle description	Type of vehicle used in the test.
Antenna description	Type of antenna used in the test.
Test code:	Designator for test.
Vehicles in the test:	Number of vehicles being tested.
Rec freq	Tuned frequency of the receiver.
Spec anal. BW	Bandwidth setting on the spectrum analyzer.
Engine speed	Rotational speed of vehicle's engine.
Antenna position	Antenna placement with respect to vehicle. (angle and distance).
Measured APD Values:	
Point	APD point identifier.
Prob	APD probability level.
PC/S	ACR number of positive voltage threshold crossings per second.
dBrms	Noise threshold voltage level in dB above rms.
Cal RMS	Rms envelope in dB(μV) with calibrated noise source.
Vavg	Average voltage of the noise envelope in dB(μV).
Vd	Voltage deviation of the noise envelope in dB.
Vp	Peak voltage of the noise envelope in dB(μV).
Noise P.	Average power of the IF noise signal in dBm (assuming 50 ohms).
Rms level calibration statement	Rms envelope level compares to X dB above kT_o, which is equivalent to Y dBμV across 50 ohms.
APD curves	Voltage threshold levels in dB above RMS versus probability for various types of noise.
ACR curves	Number of positive threshold crossings per second (PC/S) versus voltage threshold level in dB above rms.

where

$r_a(t)$, $\phi_a(t)$ = envelope and phase of the ambient noise

$r_v(t)$, $\phi_v(t)$ = envelope and phase of the vehicular noise

$v(t)$, $\theta(t)$ = envelope and phase of the composite noise

then

$$V_a = 20 \log_{10}[E(r_a^2(t))]^{1/2} \quad \text{dB}(\mu\text{V})$$

$$V_v = 20 \log_{10}[E(r_v^2(t))]^{1/2} \quad \text{dB}(\mu\text{V})$$

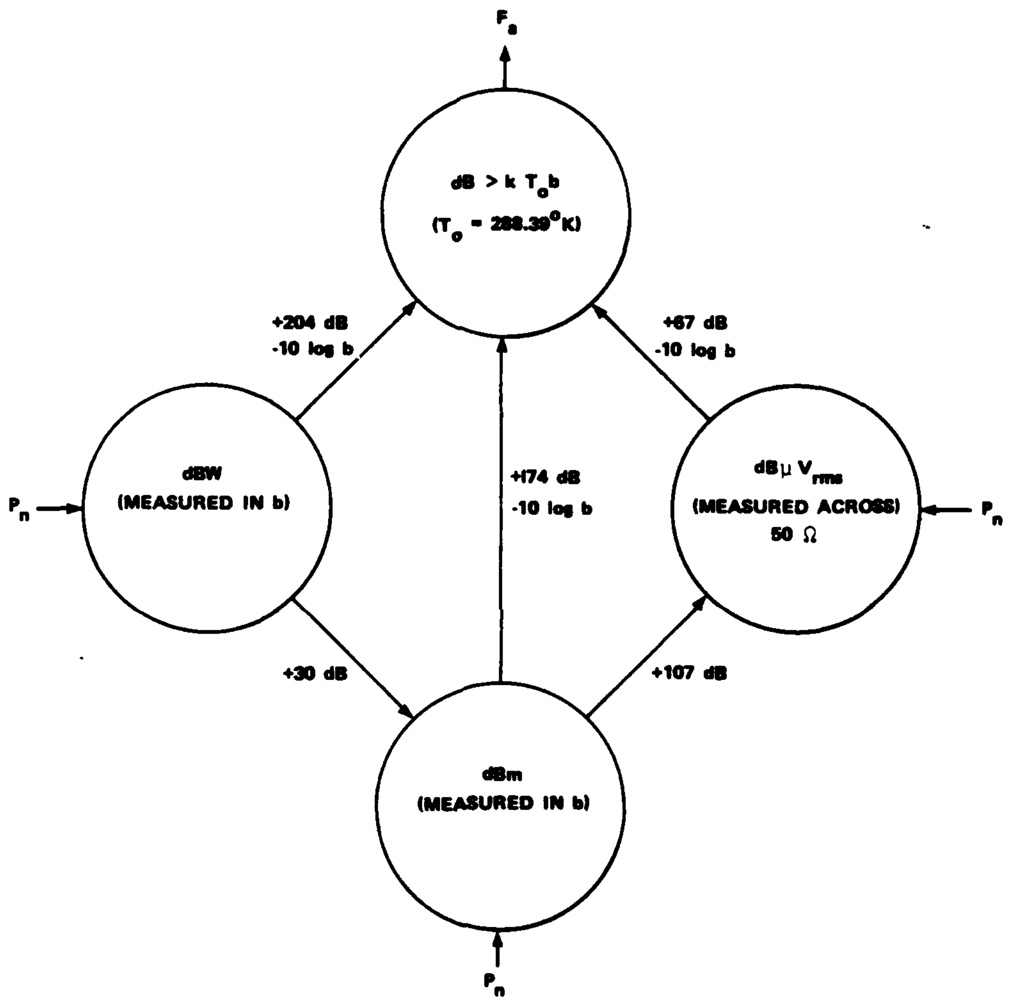
$$V_{rms} = 20 \log_{10}[E(v^2(t))]^{1/2} \quad \text{dB}(\mu\text{V})$$

Confusion arises as to the description of these rms parameter values in terms of dB(μV) (i.e., dB relative to the power expended by a 1-μV source across the same impedance). Reference 1 provides some guidance in the use of this unit, in addition to presenting the factors to convert to other types of units. Figure 7 (ref 1) is a simplified diagram which can be used for these conversions. For example, if V_{rms} measured across a 50-ohm load is 67 dB(μV), then the corresponding dBm value would be 67 dB(μV) - 107 dB = -40 dBm.

(3) As described in appendix 2, paragraph 2.2.2c, the calibrated noise source provides an output level which is considered in NATE system reference. For a specific test, the rms noise level in dB(μV) due to this source is listed under the column marked Col. RMS in figure 6. In the example this value is 52.6 dB(μV). By applying figure 7 and noting that the measured rms voltages include an IF gain factor, it can be shown that the 52.6 dB(μV) value is approximately equal to 35 dB > KT_ob (see para 2.2.2c for example). The measured rms voltage values for an actual measurement are presented above the APD and ACR plots as illustrated in figure 6. These values are given in terms of dB > KT_ob and dB(μV). In the example, the measured rms voltage across 50 ohms is 46.89 dB(μV). Using the same procedure presented in paragraph 2.2.2c and figure 7, this voltage is equal to 46.89 dB(μV) - 40 dB + 67 dB - 10 log (30 kHz) or 29.3 dB. The IF gain factor of 40 dB has been subtracted from the 46.89-dB value to arrive at the appropriate dB > KT_ob. These rms voltage levels are used as the reference for the measured APD and ACR values (see fig. 6 for example). For example, if at a specific probability the measured APD value for vehicular noise was equal to 46.89 dB(μV), then the plot would indicate a value of 0 dB.

(4) Straight-line approximations representing the Weibull distribution were fit to the measured APD data by use of regression techniques for the ambient and vehicular noise regions. Figure 8 presents an example of the computer printouts showing the straight-line parameters and their estimates. The figure includes a legend which identifies the key headings. The data from figure 8 were then used to construct APD plots similar to figure 9 for all frequency-bandwidth-vehicle combinations. The plot depicted in figure 9 represents the two highlighted lines shown in figure 8. The first line corresponds

(Text continued on page 2-19)



NOTE: P_n IN APPROPRIATE UNITS

F_a IN dB > k T_ob

Figure 7. Relationships between units for average noise power and effective antenna noise factor (rms detector) with input power, P_n.

APD LINE PARAMETERS TEST 1

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	40.01	0.3926	-0.361	23.34	5.0221	-100.836	39.64	43.41	0.0014
ADJUSTED:		39.74	0.3926	-0.361	23.34	5.0221	-100.836	39.64	43.41	0.0014
1	2	46.03	0.9399	-14.503	34.40	8.6186	-178.324	40.97	42.67	0.0276
ADJUSTED:		42.17-	1.1749	-20.027	35.99	8.6186	-178.324	40.97	42.53	0.0437
1	3	41.89	0.4969	-5.331	35.42	3.2964	-69.798	41.86	46.06	0.0168
ADJUSTED:		42.75	0.4969	-5.331	35.42	3.2964	-69.798	41.86	46.06	0.0168
2	1	19.33	0.8875	-4.995	15.34	3.2964	-32.268	19.09	22.64	0.0407
ADJUSTED:		20.62	0.8875	-4.995	15.34	3.2964	-32.268	19.09	22.64	0.0407
2	2	21.16	0.4186	0.980	14.48	2.8527	-29.078	19.97	24.70	0.0162
ADJUSTED:		21.15	0.4670	0.181	14.91	2.8527	-29.078	19.97	24.53	0.0203
2	3	21.37	0.4908	1.196	9.42	2.0194	-21.122	20.90	29.20	0.0011
ADJUSTED:		21.18	0.4908	1.196	9.42	R 2.0000	-20.880	20.88	29.25	0.0010
2	4	30.18 *	0.2032	4.063	24.01	2.8528	-43.931	30.38	36.23	0.0026
ADJUSTED:		31.28	0.2032	4.063	24.01	2.8528	-43.931	30.38	36.23	0.0026
2	5	33.84	0.1404	5.409	35.19	1.6238	-25.990	32.51	42.33	0.0010
ADJUSTED:		34.06	0.1755	4.508	28.85	1.6238	-25.990	32.51	42.12	0.0013
3	2	27.07	0.2369	2.709	27.36	1.7627	-14.846	17.12	23.01	0.0304
ADJUSTED:		27.06	0.2489	2.465	26.58	R 2.0000	-17.211	17.21	22.47	0.0348
3	3	33.11	0.1657	3.948	39.93	2.0583	-22.579	21.89	28.03	0.0145
ADJUSTED:		33.95	0.2071	2.945	33.68	R 2.0000	-21.850	21.85	27.66	0.0222
3	4	38.09	0.1473	4.264	46.63	2.2943	-30.781	26.62	32.65	0.0096
ADJUSTED:		39.09	0.1841	3.287	38.85	R 2.0000	-26.405	26.41	32.70	0.0141
3	5	44.27	0.1101	5.392	62.20	2.0194	-31.118	30.80	38.25	0.0036
ADJUSTED:		48.88+	0.1376	4.598	48.81	R 2.0000	-30.784	30.78	38.00	0.0052
4	4	23.50	0.1281	6.017	34.60	2.2943	-22.831	19.69	26.63	0.0027
ADJUSTED:		26.43	0.1601	5.346	25.47	R 2.0000	-19.407	19.41	26.91	0.0036
4	5	33.02	0.0928	6.809	57.75	2.1511	-26.065	24.11	31.94	0.0012
ADJUSTED:		40.57++	0.1160	6.268	40.47	R 2.0000	-23.943	23.94	32.07	0.0015

LEGEND:

FREQ = Test Measurement Frequency
- 1-23 MHz
- 2-75 MHz
- 3-300 MHz
- 4-900 MHz

BW = Test Measurement Bandwidth
- 1-3 kHz
- 2-10 kHz
- 3-30 kHz
- 4-100 kHz
- 5-300 kHz

VTRMS = Measured V_{rms} in dB(μV), if on the first line.

VTRMS = Calculated V_{rms} in dB(μV), if on the ADJUSTED line.

MV = M_v parameter of Weibull distribution for vehicular noise component.

KV = 10 $\log_{10} k_v$, where k_v is k Weibull distribution parameter for the vehicular noise component.

VVRMS = Calculated vehicular noise component in dB(μV)

MA = m_a parameter of Weibull distribution for ambient noise component.

KA = 10 $\log_{10} k_a$, where k_a is k Weibull distribution parameter for ambient noise component.

VARMS = Calculated ambient noise component in dB(μV)

INTERSECT: DB PROB = Coordinate point on APDIS plot where lines for ambient and vehicular noise regions intersect.

* = Measured V_{rms} less than ambient

R = Rayleigh ambient slope

Figure 8. Example computer printout from PDP 11/45 for APD regression analysis.

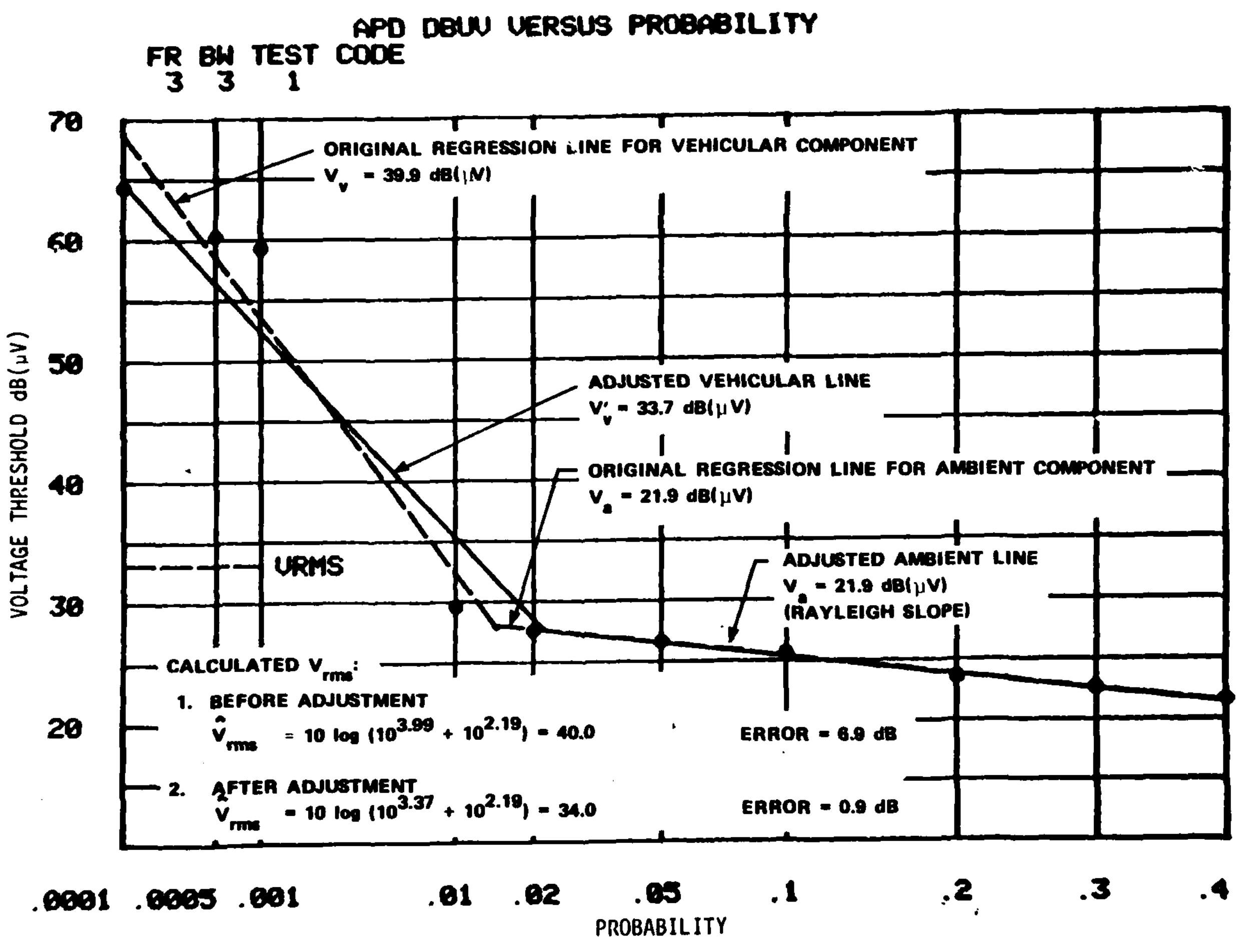


Figure 9. Example plot of single-vehicle APD data with adjusted straight line approximations.

to the estimated (using regression) APD line parameter values which have not been adjusted using the pivoting technique described in appendix 3. This technique involves the rotation of the two straight-line approximations (i.e., one for the ambient region and one for the vehicle region) about their midpoint to conform more closely to theoretical values. The dashed line annotated with VRMS in figure 9 is the measured V_{rms} designated under VTRMS [i.e., 33.1 dB(μV)] in figure 8. Theoretically, the mean-square sum of the vehicular (V_v) and ambient (V_a) noise voltage components (VVRMS and VARMS in figure 8) should equal the overall measured V_{rms} (VTRMS in figure 8). However, as seen in figure 9, their sum is 40.0 dB(μV), an error of 6.9 dB. When the vehicular line has been adjusted by a 20-percent change in slope, and the ambient line has been rotated to the theoretical Rayleigh slope (MA=2), the VTRMS value drops to 34.0, because the rms vehicular noise component VVRMS changes from 39.9 to 33.7, and VARMS was virtually unchanged. The original regression lines for the ambient and vehicular noise regions intersect at a voltage threshold of 28.0 dB(μV) and a probability equal to 0.0145 (see the last 2 columns in fig. 8). With pivoting, these values change to 27.7 dB(μV) and 0.0222, respectively. The slanted solid lines depicted in figure 8 are the adjusted straight-line approximations. The Weibull parameter values of MV, MA, KV, and KA listed in figure 8 are used to calculate the slopes and intercepts for both the vehicular and ambient noise region straight-line approximations. Appendix 3 provides a detailed discussion of the V_a and V_v parameters and presents equations relating them to the Weibull parameter values. Computer printouts and plots for the regression analysis of the APD data is also included in appendix 3.

b. Noise Parameter Data

(1) Sample medians, means, standard deviations, and cumulative distribution functions were calculated from the raw data for the various noise parameters (V_{rms}, V_{av}, V_p, V_v, and V_a). Sample plots of these data for each frequency and the bandwidths used in the performance tests are presented in appendix 3.

(2) A regression analysis was also performed by using the univariate straight-line model to relate the noise parameters to bandwidth, frequency, and each other. Results of this analysis were tabulated, and an example plot for V_{rms} versus bandwidth is illustrated in figure 10. The points around the line represent the V_{rms} values recorded at a specific NATE receiver IF bandwidth during the tests designated at the top of the figure. For the example, the standard error of the estimate (STD ERROR EST) is 2.7 dB. This indicates a small variability about the estimated line. Regression lines for the noise parameters are included in appendix 3.

2.3.2 Multiple-Vehicle Tests

a. Straight-line approximations to the Weibull distributions were also fit to the vehicular and ambient regions of the APD curves of multiple-vehicular noise data. In addition, frequency and bandwidth regressions of multiple-vehicle analysis were performed for each of the noise parameters. Results of these regressions are presented in graphic form as part of appendix 3.

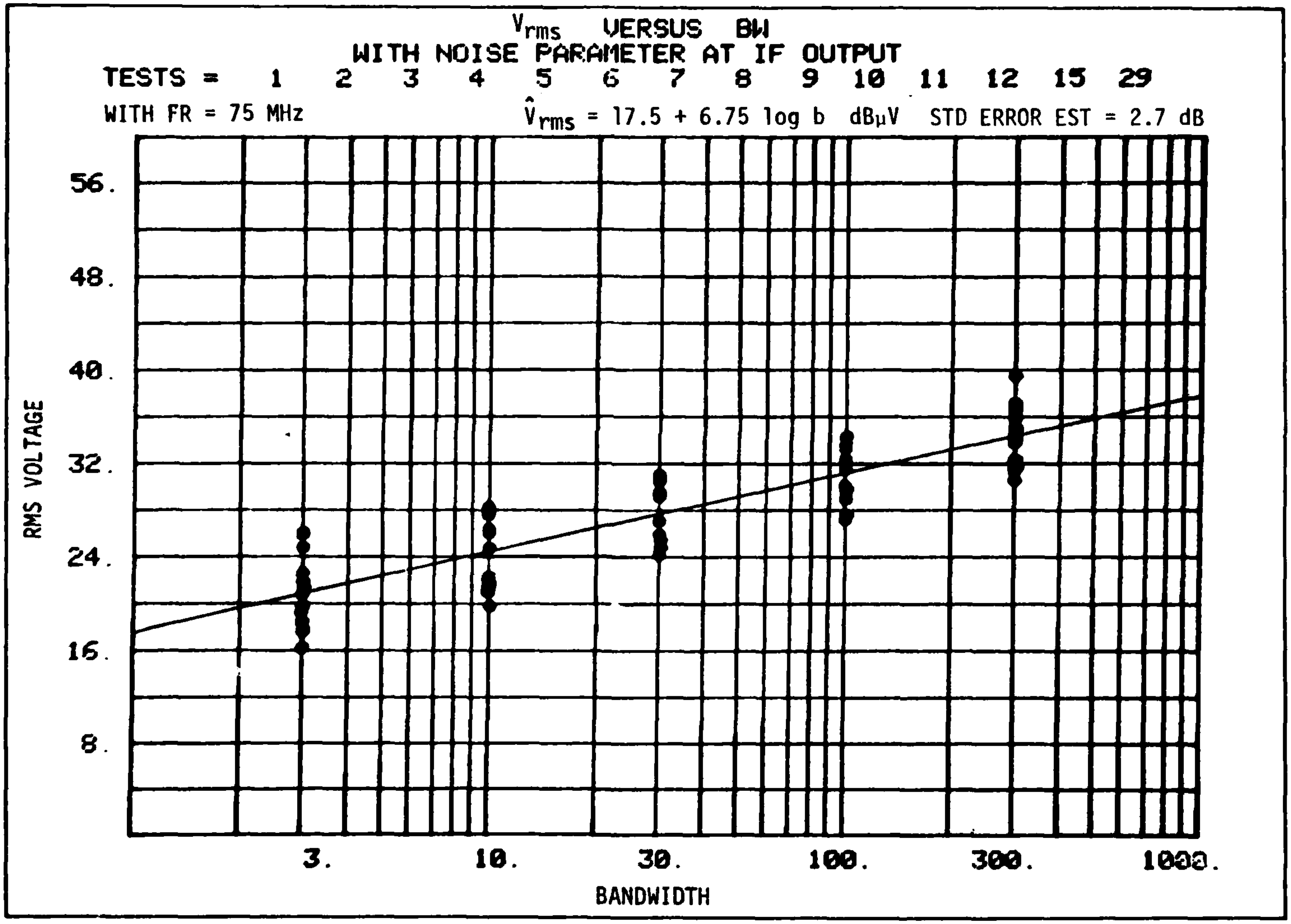


Figure 10. Example regression analysis plot for V_{rms} versus bandwidth.

b. The vehicular noise components for each of the individual vehicles used in a multiple-vehicle test were summed on a mean-square basis, and the results were compared to the overall vehicular component determined from the measurements. Figures 11 and 12 present typical plots of measured and predicted APD curves by using straight-line approximations over the vehicular and ambient noise regions. Additional plots and tabulation of the data are given in appendix 3. The recorded V_{rms} level for the specific test has been indicated on these plots for reference. The solid line represents the results of the linear regression for the multiple-vehicle measured data. The squares show the predicted value for multiple-vehicle data derived from measurements on individual vehicles. The various dashed lines are APD straight-line approximations for individual vehicles, as indicated by the test code at the top of the figure (see table III). Figure 11 is an example of a case in which the predicted V_v was quite good, to within 1 dB, but the predicted vehicular line had a large error in slope. Figure 12 is a case in which both level and line slope were predicted with reasonable accuracy.

2.3.3 Communication System Performance Tests

a. Values for the noise parameters were referenced back to their levels at the RF input by compensating for the attenuator settings recorded during these tests. This enabled the plotting of AS and AI versus S/V_{rms}, S/V_a, S/V_v, S/V_{av}, and S/V_p (S/V in dB is equal to S-V, where S and V are in dB relative to the same reference) referenced to the RF input of the receivers. Noise parameter data used were obtained at a 10-kHz bandwidth for the SSB system (AN/GRC-106), 30 kHz for the FM (AN/VRC-12) and AM (AN/ARC-51) systems, and 300 kHz for the FM/PCM (AN/GRC-103) system. Table V lists the data for each frequency and bandwidth considered, and figures 13 through 16 give plots of the data. In the data, the signal (S) and noise parameter levels are in dB(μV) at the receiver input. V_v for test 30 (no vehicles) is the computed value of the ambient component.

b. The AS and AI relationship was determined for each receiver by means of regression and by use of the following Gompertz (or "growth") function

$$\ln\,[-\ln(\hat{AS})] = a_o + a_1\,(AI)$$

where AS and AI are expressed as decimal fractions. This function form had been found in previous testing to provide a good fit to the AS-AI data (ref 7). A second-order regression was made to combine the results from all communication types. The results are shown in figure 17. Figure 18 presents the results of all the frequencies, bandwidths, and vehicle combinations considered during the entire test. For comparison purposes, figure 18 also gives the AS-AI relationship obtained with linearly mixed, white Gaussian noise.

(Text continued on page 3-1)

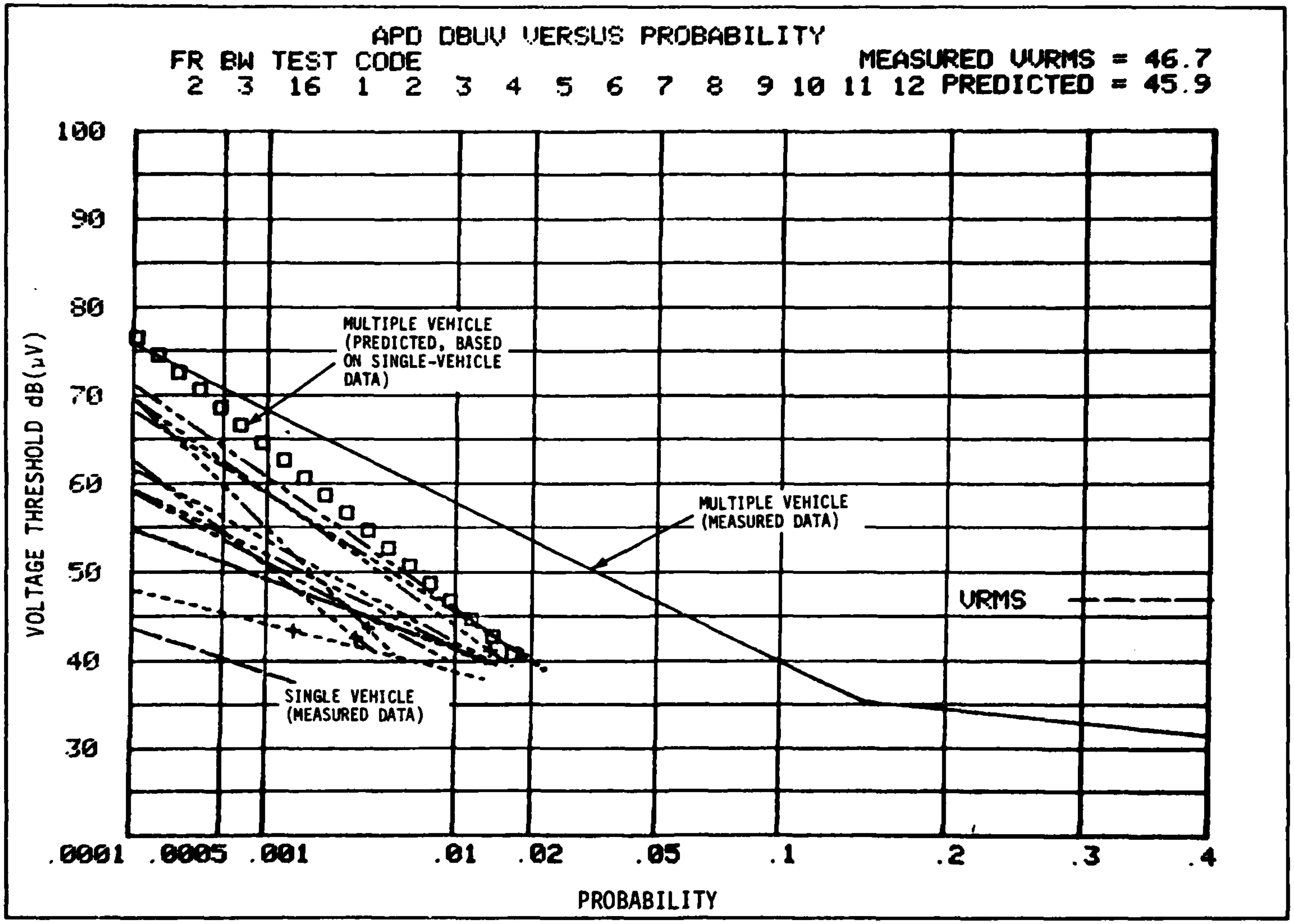


Figure 11. Measured and predicted APD curves, example 1.

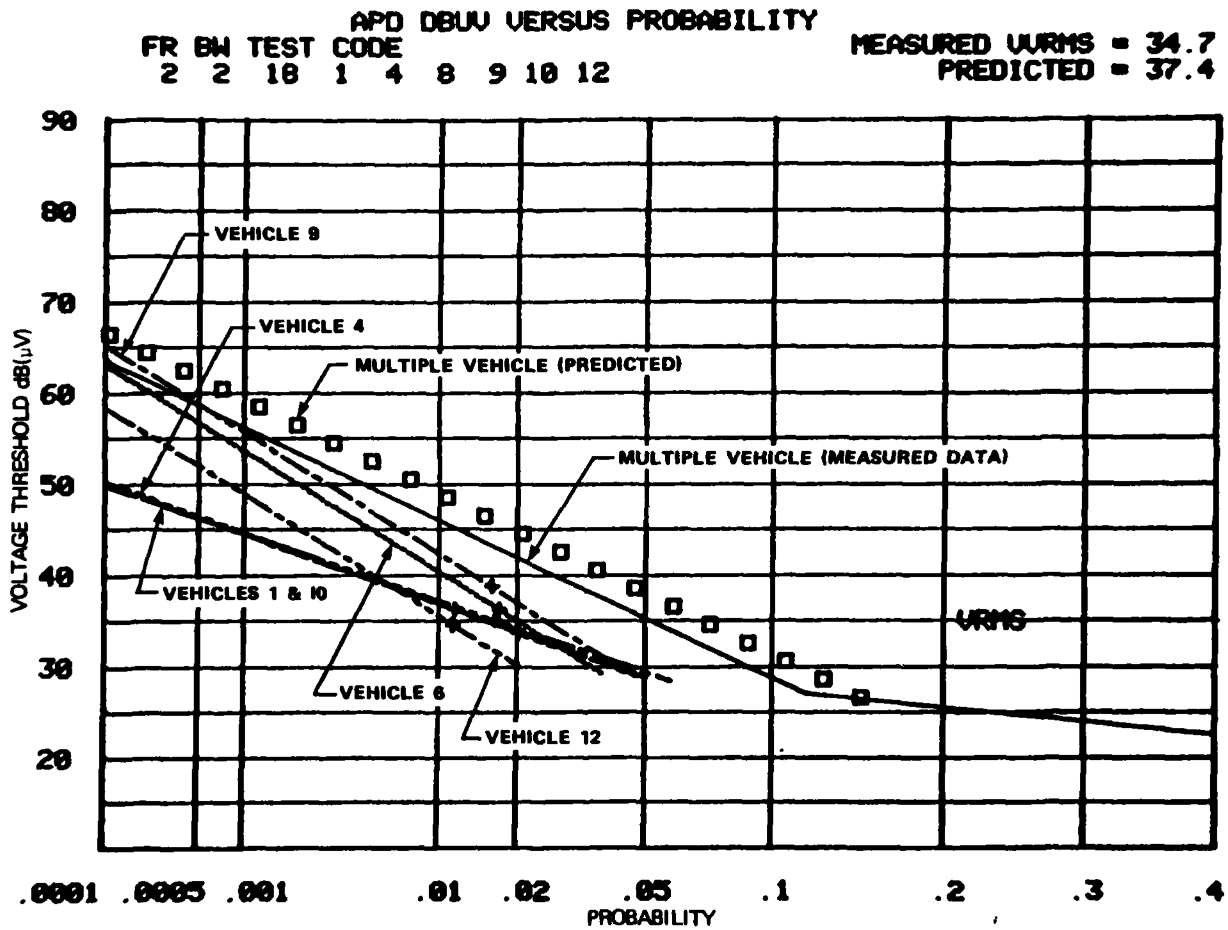


Figure 12. Measured and predicted APD curves, example 2.

TABLE V. COMMUNICATION SYSTEM PERFORMANCE RESULTS FOR SSB, FM, AM, AND FM/PCM

LINK = SSB FREQ = 23 MHZ BANDWIDTH = 10 KHZ

TEST	VEHS	S	AI	AS	VP	VRMS	VAV	VV	VA	VD
30	0	-14.	0.280	49.7	7.1	0.6	0.4	-0.3	0.6	0.2
30	0	-12.	0.409	60.6	7.1	0.6	0.4	-0.3	0.6	0.2
30	0	-9.	0.520	74.6	7.1	0.6	0.4	-0.3	0.6	0.2
29	1	4.	0.248	26.8	35.4	11.5	9.8	7.4	9.6	1.8
29	1	4.	0.358	35.0	32.4	8.5	6.8	4.4	6.6	1.8
29	1	4.	0.510	79.5	25.4	1.5	-0.2	-2.6	-0.4	1.8
15	1	-18.	0.240	25.3	11.6	-10.5	-11.9	-15.3	-12.2	1.5
15	1	-13.	0.360	53.3	11.6	-10.5	-11.9	-15.3	-12.2	1.5
15	1	-8.	0.496	74.7	11.6	-10.5	-11.9	-15.3	-12.2	1.5
21	3	-14.	0.304	58.3	10.2	-7.4	-8.5	-11.9	-8.9	1.2
21	3	-10.	0.397	67.7	10.2	-7.4	-8.5	-11.9	-8.9	1.2
21	3	-8.	0.488	77.7	10.2	-7.4	-8.5	-11.9	-8.9	1.2
17	6	-7.	0.307	52.5	13.3	-5.0	-7.1	-7.3	-7.9	2.1
17	6	-5.	0.396	73.4	13.3	-5.0	-7.1	-7.3	-7.9	2.1
17	6	-2.	0.500	85.4	13.3	-5.0	-7.1	-7.3	-7.9	2.1
16	12	-6.	0.293	45.7	21.8	-1.8	-4.9	-2.7	-6.9	3.1
16	12	-4.	0.394	80.6	21.8	-1.8	-4.9	-2.7	-6.9	3.1
16	12	-1.	0.492	80.6	21.8	-1.8	-4.9	-2.7	-6.9	3.1

LINK = FM FREQ = 75 MHZ BANDWIDTH = 30 KHZ

TEST	VEHS	S	AI	AS	VP	VRMS	VAV	VV	VA	VD
30	0	-6.	0.302	57.7	-2.2	-9.8	-10.1	-9.2	-9.8	0.3
30	0	-4.	0.405	53.1	-2.2	-9.8	-10.1	-9.2	-9.8	0.3
30	0	-3.	0.498	74.0	-2.2	-9.8	-10.1	-9.2	-9.8	0.3
29	1	6.	0.238	46.0	30.1	10.5	8.8	6.0	9.0	1.7
29	1	6.	0.352	61.5	28.1	8.5	6.8	4.0	7.0	1.7
29	1	6.	0.520	81.2	26.1	6.5	4.8	2.0	5.0	1.7
15	1	-17.	0.265	47.7	3.7	-9.4	-12.5	-12.5	-12.4	3.1
15	1	-15.	0.347	67.4	3.7	-9.4	-12.5	-12.5	-12.4	3.1
15	1	-8.	0.510	85.3	3.7	-9.4	-12.5	-12.5	-12.4	3.1
21	3	3.	0.300	38.3	31.2	4.5	-5.3	4.3	-8.2	9.9
21	3	5.	0.379	65.3	31.2	4.5	-5.3	4.3	-8.2	9.9
21	3	7.	0.489	77.0	31.2	4.5	-5.3	4.3	-8.2	9.9
17	6	13.	0.260	25.4	29.2	4.8	-0.6	3.9	-2.7	5.4
17	6	14.	0.374	57.7	29.2	4.8	-0.6	3.9	-2.7	5.4
17	6	15.	0.485	75.1	29.2	4.8	-0.6	3.9	-2.7	5.4
16	12	4.	0.307	57.1	32.0	6.9	-2.3	6.7	-7.6	9.1
16	12	8.	0.389	66.9	32.0	6.9	-2.3	6.7	-7.6	9.1
16	12	14.	0.498	72.9	32.0	6.9	-2.3	6.7	-7.6	9.1

LINK = AM FREQ = 300 MHZ BANDWIDTH = 30 KHZ

TEST	VEHS	S	AI	AS	VP	VRMS	VAV	VV	VA	VD
30	0	-7.	0.307	43.4	-10.3	-20.2	-21.0	-21.1	-20.2	0.8
30	0	-5.	0.397	62.0	-10.3	-20.2	-21.0	-21.1	-20.2	0.8
30	0	-2.	0.497	70.9	-10.3	-20.2	-21.0	-21.1	-20.2	0.8
29	1	5.	0.265	55.3	39.4	9.7	2.4	8.9	1.8	7.3
29	1	5.	0.361	76.7	36.4	6.7	-0.6	5.9	-1.2	7.3
29	1	5.	0.493	84.6	31.4	1.7	-5.6	0.9	-6.2	7.3
15	1	-8.	0.235	47.0	16.4	-10.1	-17.4	-10.2	-18.1	7.3
15	1	-4.	0.362	66.0	16.4	-10.1	-17.4	-10.2	-18.1	7.3
15	1	4.	0.516	82.5	16.4	-10.1	-17.4	-10.2	-18.1	7.3
21	3	-7.	0.313	53.7	19.1	-13.4	-19.5	-14.4	-20.2	6.1
21	3	-4.	0.414	69.7	19.1	-13.4	-19.5	-14.4	-20.2	6.1
21	3	-1.	0.507	81.3	19.1	-13.4	-19.5	-14.4	-20.2	6.1
17	6	-6.	0.282	44.8	17.0	-9.8	-15.5	-10.8	-16.7	5.7
17	6	-2.	0.411	63.1	17.0	-9.8	-15.5	-10.8	-16.7	5.7
17	6	1.	0.495	75.7	17.0	-9.8	-15.5	-10.8	-16.7	5.7
16	12	-5.	0.290	45.4	17.8	-7.8	-15.5	-8.3	-17.7	7.7
16	12	-2.	0.400	61.7	17.8	-7.8	-15.5	-8.3	-17.7	7.7
16	12	1.	0.503	70.2	17.8	-7.8	-15.5	-8.3	-17.7	7.7

TABLE V. COMMUNICATION SYSTEM PERFORMANCE RESULTS FOR SSB, FM, AM, AND FM/PCM (CONT)

LINK = FM/PCM FREQ = 900 MHZ BANDWIDTH = 300 KHZ

TEST	VEHS	S	AI	AS	VP	VRMS	VAV	VV	VA	VD
30	0	12.	0.576	74.9	1.6	-8.7	-9.5	-9.4	-8.7	0.8
29	1	20.	0.801	91.1	31.5	8.0	3.9	6.0	3.8	4.1
15	1	12.	0.740	85.5	36.9	-4.5	-6.5	-6.3	-6.4	2.0
21	3	13.	0.688	93.3	18.1	-8.0	-9.2	-14.5	-9.1	1.2
17	6	11.	0.623	89.3	36.5	-2.0	-7.8	-3.3	-8.1	5.8
16	12	11.	0.480	72.5	31.2	-5.7	-8.1	-5.7	-8.0	2.4

LEGEND:

LINK = Identifies communication system tested
FREQ = Operational frequency
BANDWIDTH = NATE system bandwidth
TEST = Test code as listed in table III
VEHS = Number of vehicles tested
AI = Articulation index
AS = Articulation score
VP = V_p = Peak noise threshold in dB(μV)
VRMS = V_{rms} = rms noise value dB(μV)
VAV = V_{av} = average noise value dB(μV)
VV = Vehicular noise component dB(μV)
VA = Ambient noise component dB(μV)
VD = Logarithmic difference of VRMS and VAV

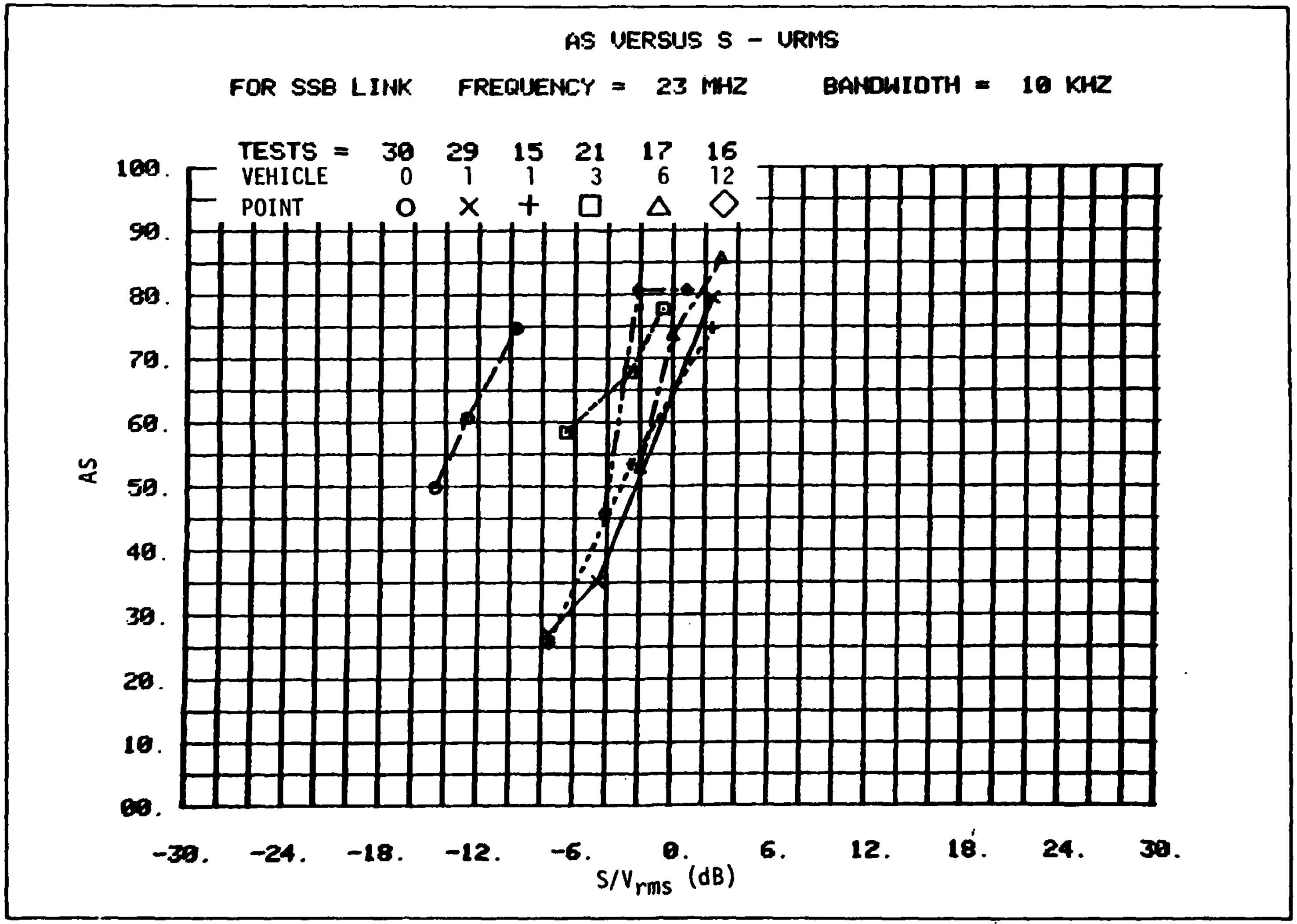


Figure 13. Communication system performance for SSB (AN/GRC-106) link showing AS versus S-V_{rms} for single and multiple noise conditions at 23 MHz.

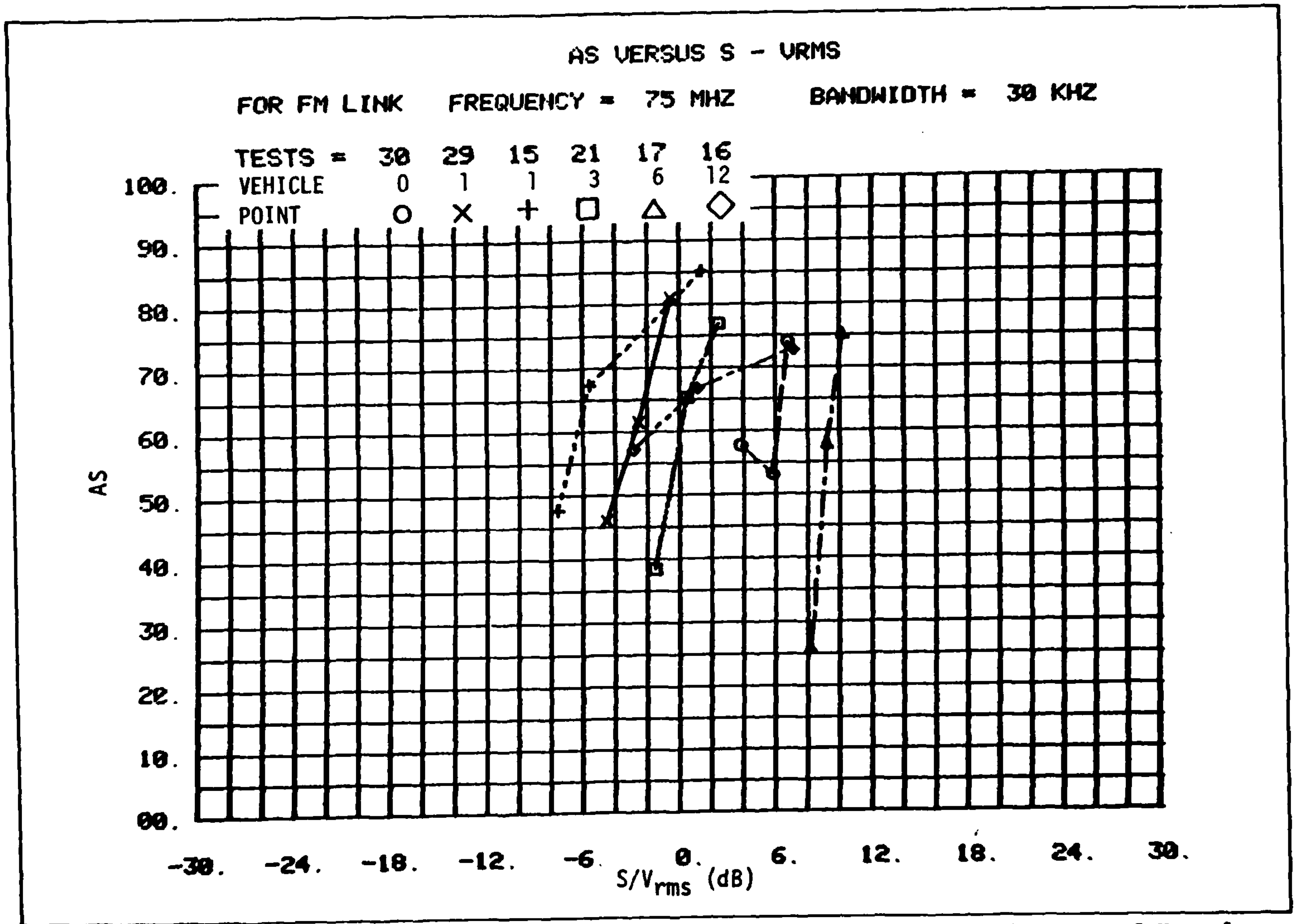


Figure 14. Communication system performance for FM (AN/VRC-12) link showing AS versus S-V_{rms} for single and multiple noise conditions at 75 MHz.

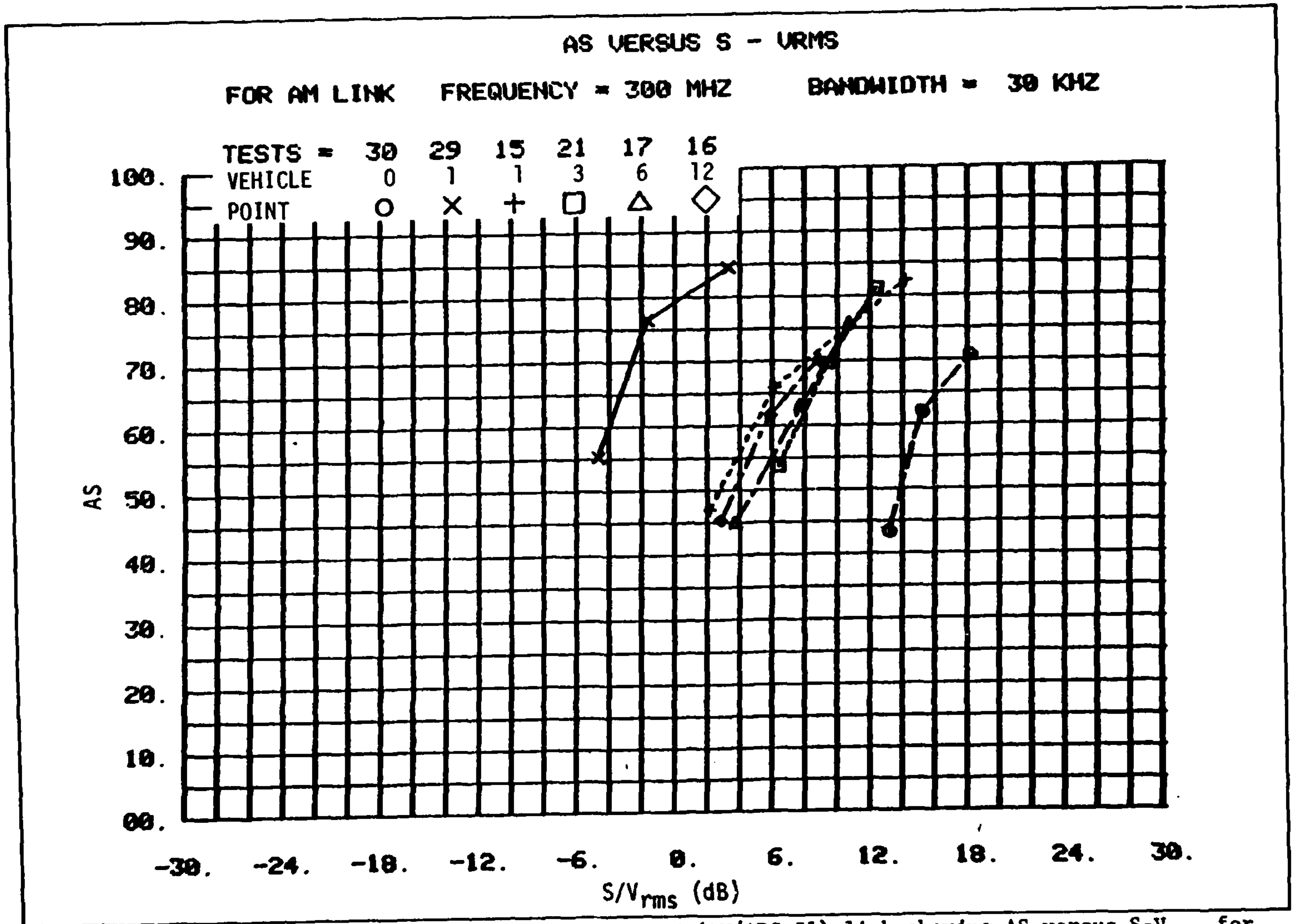


Figure 15. Communication system performance for AM (AN/ARC-51) link showing AS versus S-V_{rms} for single and multiple noise conditions at 300 MHz.

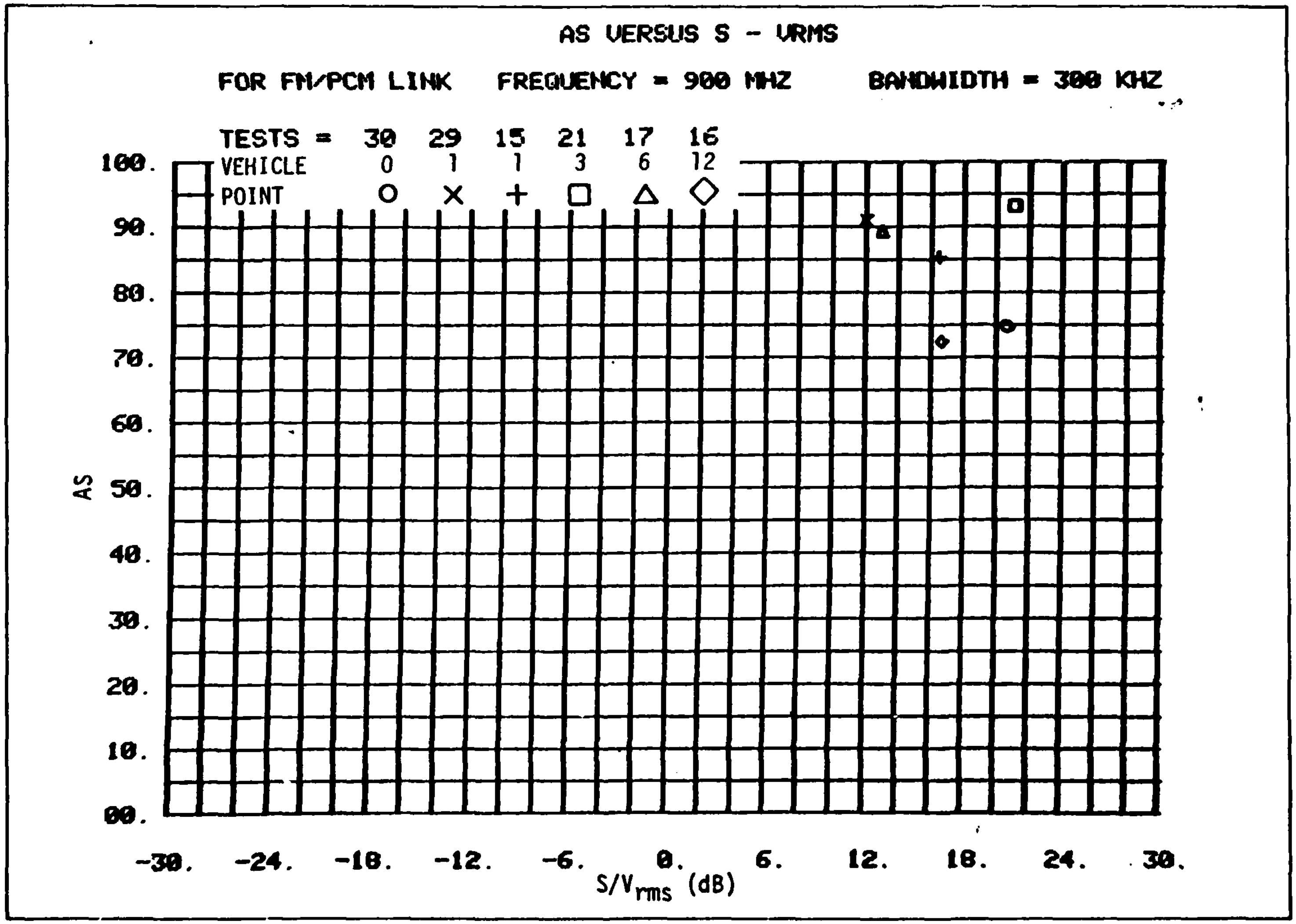


Figure 16. Communication system performance for FM/PCM (AN/GRC-103) showing AS versus S-V_{rms} for single and multiple noise conditions at 900 MHz.

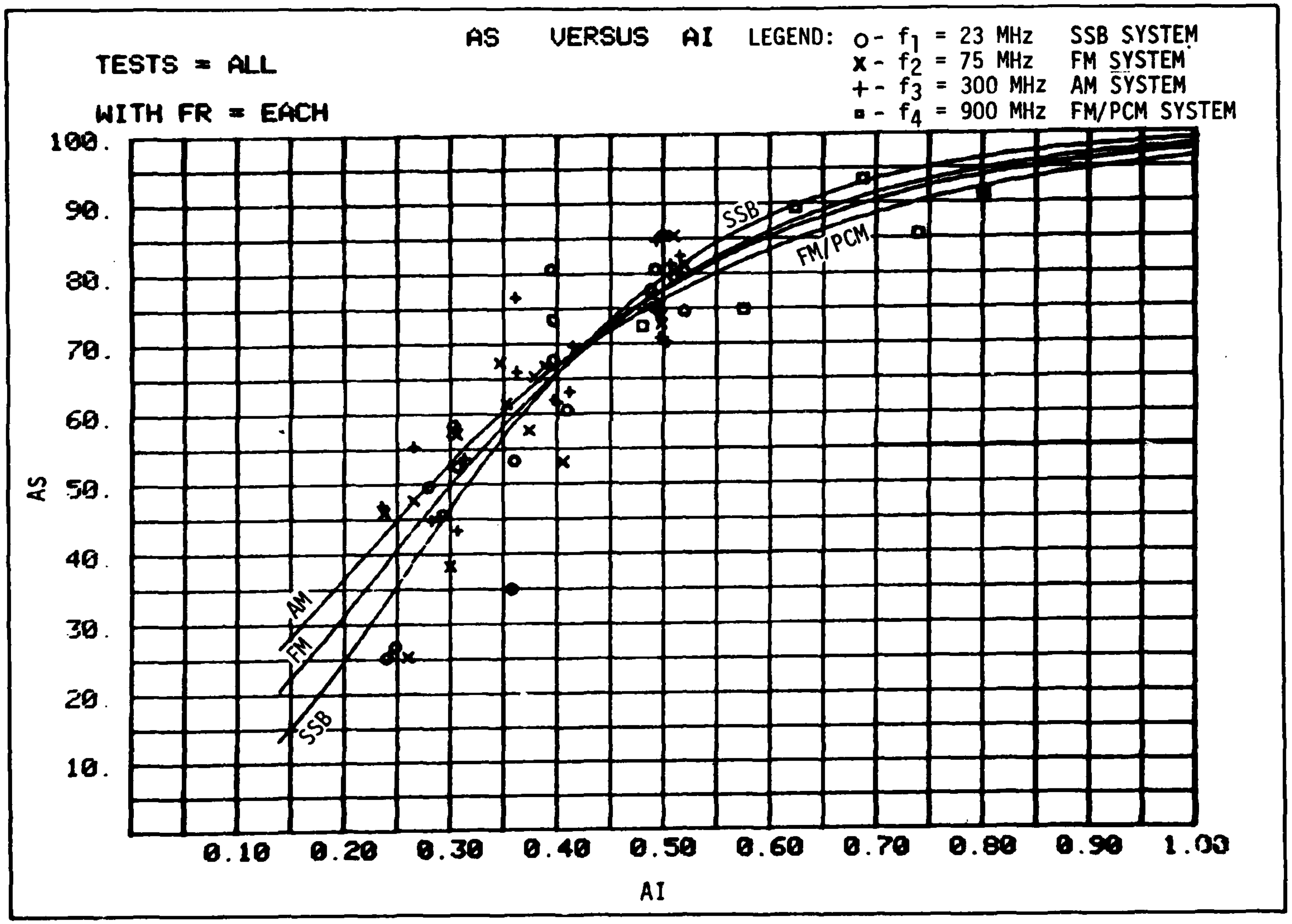


Figure 17. AS versus AI summary plots and regression approximations for four operational frequencies.

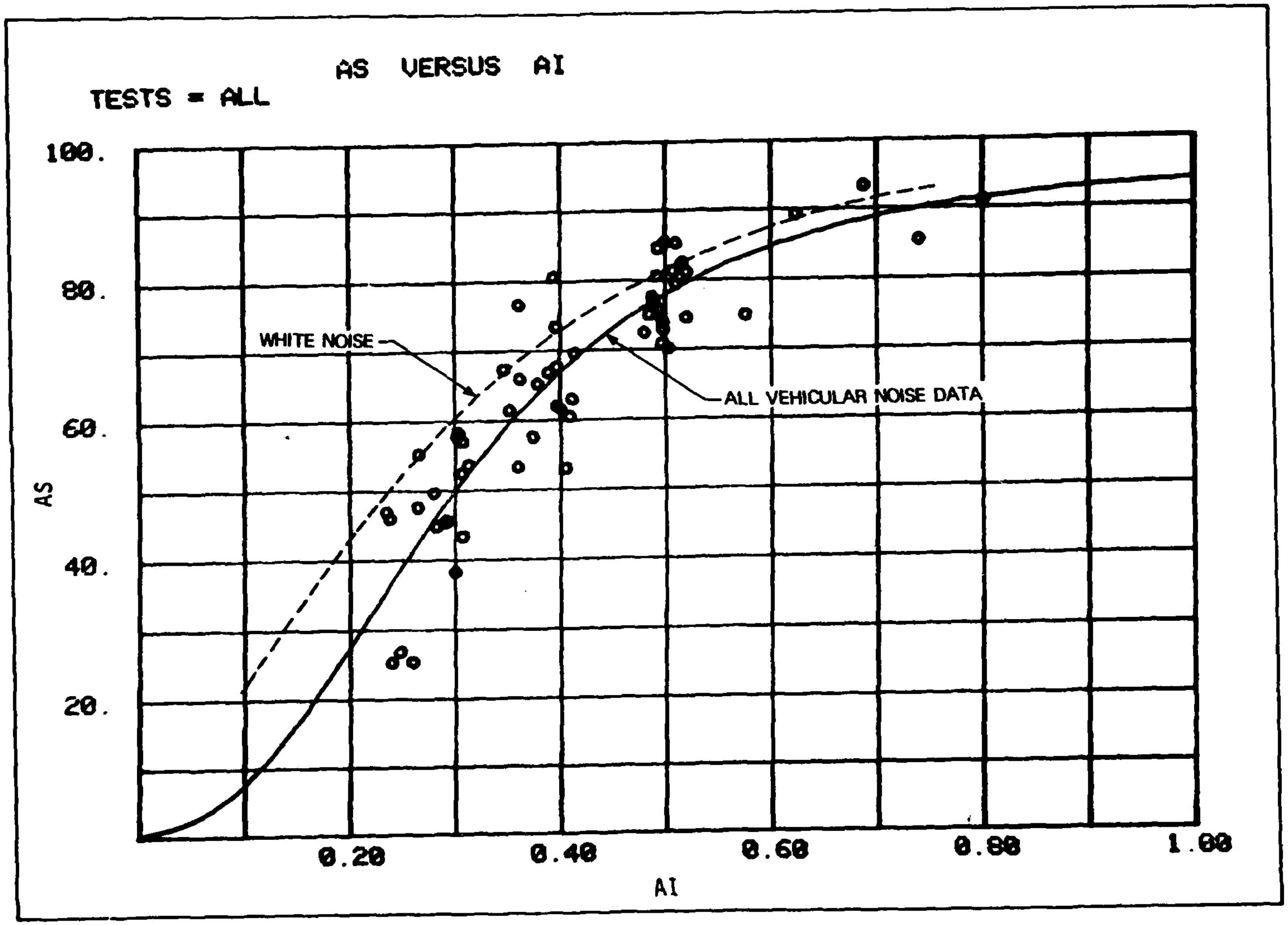


Figure 18. Combined AS versus AI plots and regression approximations for all frequencies and system types.

SECTION 3 - MAJOR RESULTS OF THE ANALYSIS

3.1 FUNCTIONAL RELATIONSHIP OF V_p, V_{av}, AND V_{rms} WITH BANDWIDTH, b

a. A regression analysis was conducted by using the univariate linear model, $Y = a_0 + a_1 \log b + e$, to determine the functional relationship of measured V_p, V_{av}, and V_{rms} noise data with the corresponding IF bandwidth of the noise signal. The analyzed vehicle data are summarized in table VI for a 95-percent significance criteria. Data on the vehicular component of the voltage, V_v, and the ambient voltage component, V_a, are listed in table VII for comparison. A previous report (ref 1) defined parameters and showed that V_p varies as 20 log b; whereas V_{rms} varies as 10 log b. The ambient and vehicular components (V_a and V_v) were also expected to vary as 10 log b. Overall, these expectations were substantiated by the analysis results presented in table VI.

b. As shown in table VI, large variations from the straight-line estimate and relatively small correlation coefficients (i.e., r = 0.24 and 0.34, respectively) for both V_v and V_{av} at the 23-MHz test frequency tended to mask the log b rule. Only two values of bandwidth were tested at 900 MHz. This resulted in very broad confidence limits for the slope of the straight-line estimates for V_p and V_v.

c. In addition, a bivariate regression analysis was performed by using the model, $Y = a_0 + a_1 \log f + a_2 \log b + \varepsilon$, to show the relationship of the selected parameter with frequency and bandwidth. The regression equations with their appropriate estimates are summarized in table VII for each noise parameter versus log f and log b. For this analysis, the noise parameter data were referenced to the field strength which would be recorded at the antenna. V_{av} and V_{rms} were found to be highly correlated to the ambient noise component V_a. For this reason, when the straight-line approximation for the APD ambient region had a nominal Rayleigh slope, indicating Gaussian receiver noise, no attempt was made to reference the data for these three parameters back to field strength.

3.2 PREDICTING MULTIPLE-VEHICLE APD CURVES FROM SINGLE-VEHICLE DATA

a. Assuming power additivity, the vehicular component V_v, given in terms of dB(μV), from several vehicles should be the sum (in mean-square voltage units) of the individual vehicle's V_v components. For all frequencies except 23 MHz, different antennas were used in the single- and multiple-vehicle tests. To make the data have a common reference, the difference in antenna gains (Δ) was subtracted from the single-vehicle V_v values, and $(m_v \Delta/2)$ was added to the single-vehicle K_v values. (Refer to app 3 for detailed description of the

(Text continued on page 3-4)

TABLE VI. SUMMARY OF ESTIMATED VALUES OF NOISE PARAMETERS AS A FUNCTION OF BANDWIDTH FOR DIFFERENT FREQUENCIES FOR A 95-PERCENT SIGNIFICANCE CRITERIA

Noise Parameter	Frequency (MHz)	Estimated Values For The Model $Y = a_0 + a_1X + \epsilon$ dB(μV)[1,2]: a_1 = Slope: Value	a_1 = Slope: Confidence Limits[3]	a_0 = Intercept [dB(μV)]	Correlation Coefficient, r, Between Y and X	Standard Error Of the Estimate Y (dB)[3]	Nominal Value of Slope = a_1
Peak Voltage (V_p)	23	15.5	±6.3	-6.0	0.63	7.7	20
	75	15.6	±3.3	-5.9	0.76	9.6	20
	300	18.9	±4.26	-17.9	0.77	8.8	20
	900	19.9	±14.7	-28.6	0.49	8.8	20
Average Voltage (V_{av})	23	8.0	±7.8	-10.2	0.34	8.7	10
	75	6.2	±0.89	-14.2	0.86	2.6	10
	300	8.7	±0.58	-35.6	0.97	1.2	10
	900	10.3	±1.5	-38.9	0.94	0.9	10
Root-Mean-Square Voltage (V_{rms})	23	8.2	±7.5	-9.6	0.37	8.3	10
	75	6.8	±0.94	-13.3	0.87	2.7	10
	300	8.7	±1.8	-29.8	0.79	3.8	10
	900	11.3	±3.9	-38.6	0.76	2.4	10
Vehicular rms Component (V_v)	23	5.9	±5.0	-17.6	0.24	4.9	10
	75	6.7	±2.1	-17.1	0.62	5.9	10
	300	10.1	±3.0	-33.2	0.71	5.8	10
	900	17.2	±17.4	-53.3	0.41	9.5	10
Ambient rms Component (V_a)	23	4.7	±7.7	-8.2	0.34	7.6	10
	75	7.0	±1.0	-14.9	0.87	2.8	10
	300	9.0	±0.5	-36.6	0.98	1.0	10
	900	10.7	±1.7	-39.5	0.95	0.9	10

NOTES:

[1] X = log b, where b is the bandwidth of the IF stage in the NATE receiving system (located in the spectrum analyzer, see fig. 2).

[2] The values given by the regression, in dB(μV), are referenced to the RF input of the NATE receiver.

[3] τ-distribution with a significance level equal to 95% was used to calculate confidence limits for slope and the standard error (variability) of the estimate Y.

TABLE VII. BIVARIATE REGRESSION OF NOISE PARAMETERS IN FIELD STRENGTH IN dB (V/m) FOR ALL SINGLE-VEHICLE DATA (SEE NOTES)

Regression Equations	Std Error of Est Y (dB)	Restrictions
$\hat{V}_p = 2.15 \log f + 16.39 \log b - 1.26$	9.1	$3 \leq b \leq 300$, $23 \leq f \leq 900$
$\hat{V}_v = 1.03 \log f + 8.15 \log b - 1.26$	6.8	$3 \leq b \leq 300$, $23 \leq f \leq 900$
$\hat{V}_a = -15.77 \log f + 6.76 \log b - 22.7$	4.7	$3 \leq b \leq 30$, $23 \leq f \leq 75$
$\hat{V}_{av} = 19.31 \log f + 6.46 \log b + 29.2$	5.4	$3 \leq b \leq 30$, $23 \leq f \leq 75$
$\hat{V}_{rms} = -17.99 \log f + 6.94 \log b + 27.8$	5.3	$3 \leq b \leq 30$, $23 \leq f \leq 75$
$-2/m_v = -2.25 \log f - 2.87 \log b + 1.377$	2.74	$3 \leq b \leq 300$, $23 \leq f \leq 900$

NOTES: 1. The estimated values for the model $Y = b_0 + b_1X_1 + b_2X_2 + \varepsilon$

where

$X_1 = \log f$ (f in MHz)

$X_2 = \log b$ (b in kHz)

2. $-2/m_v$ is the slope of the vehicular line for the Weibull fit:

$$R = -\frac{2}{m_v}[X + K_v]$$

where

R = threshold level in dB(μV) of the IF envelope
$X = -\log[-\ln(\text{exceedance probability})]$
m_v, k_v = Weibull parameters

The same slope is assumed to hold when the values are referenced to the RF input and field strength.

Weibull m_v and K_v parameters.) The m_v parameter, which is a measure of the slope, remains unchanged; and the measured V_v values of the composite were compared with the corresponding calculated predicted values. The Weibull parameters m_v and K_v of the predicted composite were obtained by treating the receiver envelope detection as essentially picking the largest of independent signals at a very low probability (P_x = 0.0001), and finding m_v and K_v that gave the desired rms V_v by solving the implicit equations for m_v and K_v:

$$V_v = - \frac{2}{m_v} K_v + 10 \log [\Gamma (1 + \frac{2}{m_v})]$$

and

$$R_P = P_Z = \frac{2}{m_v} \quad 10 \log [-\ln(P_Z)] - K_v$$

where K_v = 10 $\log_{10} k_v$, and m_v are the Weibull parameters, and P_Z is the multiple-vehicle pivot probability, defined in appendix 3, paragraph 3.1.4.

b. Figure 19 is an example extract of a computer printout, which presents the comparison results for each frequency. In the example, data from three vehicles were used to calculate the predicted values of V_v. A complete set of computer printouts for all these tests are presented in appendix 3. Error conditions were flagged with the notations indicated by the legend. Those entries without flag markings on a "predicted" line are considered within bounds and represent satisfactory predictions. As illustrated in figure 19, a ++ flag on a predicted line is always paired with a -- or - on a measured line. Total counts for all the various tests and multiple-vehicle configurations are summarized in table VIII. As explained in appendix 3, paragraph 3.1.4.2, data from certain tests which exhibited gross errors were discarded in constructing table VIII. Out of the 105 multiple-vehicle tests analyzed, there were 13 cases in which the measured values of V_v differed from the calculated V_v by more than 10 dB.

c. Figures 11, 12, and 20 (see app 3 for additional plots) present examples of the fitted APD data for the multiple-vehicle tests and the individual contributing single-vehicle component lines. The data high-lighted in figure 19 were used to construct figure 20. Squares are used to indicate the predicted composite. The measured V_{rms} is also indicated on this example. Crosses on the single-vehicle lines mark where that vehicle's line intersected its ambient line. As shown in figure 20 for test 1, frequency 2 (75 MHz) and bandwidth 3 = 30 kHz, this intersection occurs at a low probability value and a level that is close to the highest voltage threshold level observed during the test.

3.3 COMMUNICATION SYSTEM PERFORMANCE

a. As previously mentioned, tests were conducted during the vehicle noise measurements to determine communication system performance on the following:

(Text continued on page 3-8)

MULTIPLE VEHICLE TEST 21 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:		28.61	0.3975	-1.507	56.10	36.22	0.0245	SOLID LINE
PREDICTED:		32.36	0.5089	-4.837	56.91	35.00	0.0700	SQUARES
FROM TEST	1	NO DATA						
	8	29.28	0.3926	-1.528	56.91	36.12	0.0273	SHORT DASH
	12	29.51	0.8710	-10.993	47.38	35.20	0.0663	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	+	44.29	0.2461	0.361	75.42	35.11	0.0529	SOLID LINE
PREDICTED:	-	39.11	0.2851	-0.277	69.60	35.14	0.0512	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	37.18	0.0017	LONG DASH
	8	38.24	0.2345	1.500	69.44	35.72	0.0246	SHORT DASH
	12	31.54	0.3078	0.179	61.49	35.72	0.0249	DOTTED LINE

	12	28.33	0.1938	3.932	58.93	31.30	0.0069	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0201,	INTERSECT. AT P		PLOT LINE
MEASURED:	-	34.70	0.1841	3.671	64.88	35.77	0.0069	SOLID LINE
PREDICTED:	++	44.83	0.1462	4.452	71.03	35.84	0.0061	SQUARES
FROM TEST	1	44.31	0.1376	4.907	68.81	36.16	0.0041	LONG DASH
	8	NO DATA						
	12	35.50	0.1597	4.557	63.67	36.22	0.0039	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	--	18.47	0.1849	5.140	48.70	31.94	0.0016	SOLID LINE
PREDICTED:	++	36.24	0.1227	6.172	56.56	31.94	0.0015	SQUARES
FROM TEST	1	35.97	0.1160	6.529	53.70	32.21	0.0010	LONG DASH
	8	NO DATA						
	12	24.31	0.1351	6.385	48.23	32.38	0.0007	DOTTED LINE

LEGEND:

Test = Type of test as found in table III
VVRMS = Rms value of the vehicular component
WEIBULL M = m_V Weibull parameter value
10 LOG(K) = K_V Weibull parameter value
FREQ = Test measurement frequency
BW = Test measurement bandwidth
DB AT P=.0001 = Value of threshold at 0.0001 (See fig. 19 for example.)
INTERSECT. AT P = Coordinate values for the intersection of the ambient and vehicular regions (See fig. 19 for example.)

The meaning of the flags (+, -, ++, --) is as follows:

1. On a "measured" line, the measured V_v differed from V_v for a contributing vehicle by between 5 and 10 dB (single sign) or by more than 10 dB (double sign).
2. On a "predicted" line, the error in predicting V_v was between 5 and 10 dB or greater than 10 dB, respectively.

Figure 19. Example extract of computer printout showing results of comparison analysis between measured and predicted V_V values for multiple vehicles.

TABLE VIII. ERROR SUMMARY OF OCCURRENCES COMPARING MEASURED V_v WITH CALCULATED MULTIPLE-VEHICLE V_v

Frequency (MHz)	Number of Measured V_v <u>Below</u> Calculated Multiple-Vehicle V_v		Number of Satisfactory Predictions	Number of Measured V_v <u>Above</u> Calculated Multiple-Vehicle V_v	
	>10 dB	>5 & <10 dB		>5 & <10 dB	>10 dB
23	1	8	8	0	0
75	1	3	23	5	4
300	2	5	25	3	1
900	6	2	10	0	0
Total of All Frequencies	10	18	66	8	3

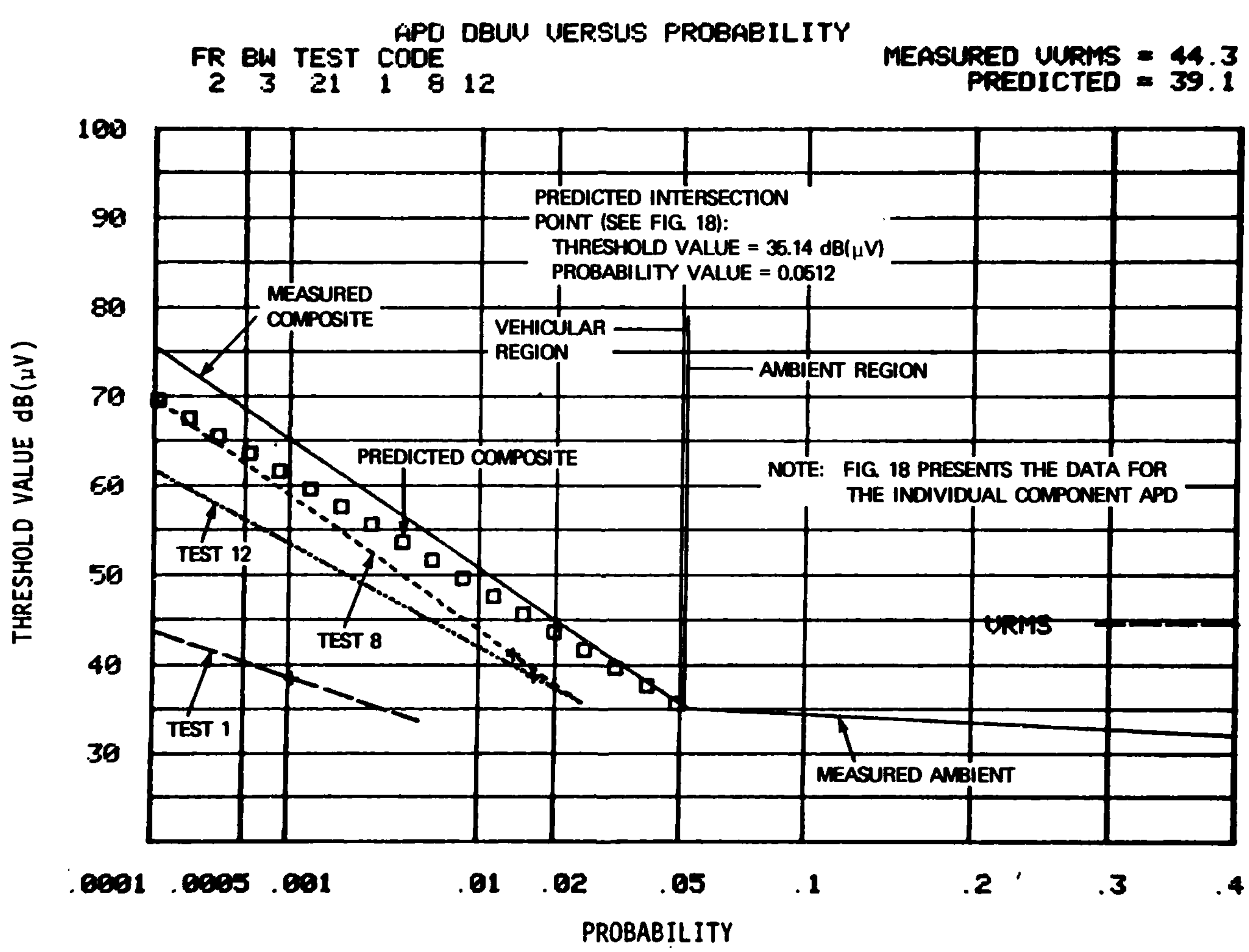


Figure 20. Example of fitted APD for multiple-vehicle tests with individual contributing single-vehicle component lines.

Equipment	Communication System Type	Frequency (MHz)
AN/GRC-106	SSB	23
AN/VRC-12	FM	75
AN/ARC-51	AM	300
AN/GRC-103	FM/PCM	900

b. The system performance data are shown on figures 13 through 16. An examination of the plots indicated that, for the SSB system, vehicular noise shifted the AS line by about 12 dB to higher (S/V_{rms}) values. For the FM, AM, and FM/PCM system, vehicular noise shifted the AS lines, generally, to lower (S/V_{rms}) values.

c. This anomalous behavior is discussed in appendix 3, paragraph 3.3, where it is concluded that V_{rms}, and indeed, all envelope parameters measured with the NATE receiver do not represent the signals that were present in the communication system. Several reasons are given.

d. The FM/PCM system was tested only at a signal level of 1 dB above the loss of synchronization. This was done because even 1 dB of added signal brought the system up to essentially clear-channel operation.

e. Examination of the S level required for a given level of performance (table V, all tests except 29) reveals that, for the FM/PCM system (AN/GRC-103) performance is strictly a function of signal level. Even with 12 vehicles there is no significant shift in the signal level required to maintain synchronization. The same is true for the SSB system (AN/GRC-106) with fewer than 6 vehicles. It appears that in these cases, performance is determined by the test receiver's internal noise level, rather than the vehicular noise. For the AM system (AN/ARC-51), the AI-versus-S curves fall into two groupings. Tests 30 and 21 (0 and 3 vehicles) are essentially identical, and tests 15, 17, and 16 (1, 6, and 12 vehicles) are almost identical. V_a appears to be the determining factor for the AM system.

f. The data for the FM system (AN/VRC-12) shows severe degradation in the 6-vehicle test, and a very steep slope of the AS versus S/V_{rms} line. The fit for test 30 (no vehicles) suggests that the ambient level may have changed while recording the AS test message at the middle signal level. A plot of AI versus S/V_{rms} is much more consistent for the no-vehicle test, and displays the steep slope generally associated with FM system performance. Generally, the slope decreases as the interference becomes more impulsive, and indeed, that was observed in the tests with 1 and 12 vehicles, but not for 3 or 6 vehicles.

SECTION 4 - REFERENCES

1. Spaulding, A. D. "Man-Made Noise: The Problem and Recommended Steps Toward Solution," OT Report 76-85, Office of Telecommunications, U.S. Department of Commerce, April 1976.

2. Society of Automotive Engineers, Inc., SAE J551e, "Limits and Methods of Measurement of Radio Interference Characteristics of Vehicles and Devices (20-1000 MHz)," June 1977.

3. Shepherd, R. A., J. C. Gaddie, and P. J. Bell. "Electromagnetic Radiation Statistics at 50 MHz and 153 MHz of the UNited States Vehicle Population," Final Report, MVMA Agreement No. SRI 7706-C2.10, SRI International Menlo Park, CA, August 1975.

4. The Wheels Study, "Vehicle EMI Suppression Measurements," Data Packet, U.S. Army Electronic Proving Ground (USAEPG), Fort Huachuca, AZ, May 1975. (Prepared by Lockheed Electronics Co., Tucson, AZ)

5. "The Impact of the Application of SAE Standard J551 Requirements to XM861 Series 1-1/4 Ton Truck," U.S. Army Electronics Command, Fort Monmouth, NJ, 2 June 1975.

6. Spaulding, A. D., and R. T. Disney. "Man-Made Radio Noise, Part I: Estimates for Business, Residential and Rural Areas," OT Report 74-38, Office of Telecommunications, Institute for Telecommunication Sciences, Boulder, CO 80302, June 1974.

7. "The Application of Voice Interference Analysis System to the Prediction of Voice Intelligibility, Part I," Bell Aerosystems Report A70009-280, November 1967.

8. Papoulis, A. Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 1965, p. 193.

9. Middleton, David. "Procedures for Determining the Parameters of the First-Order Canonical Models of Class A and Class B Electromagnetic Interference," IEEE Trans, EMC Vol, EMC-21, No. 3, August 1979.

10. Middleton, David. "Canonical Non-Gaussian Noise Models: Their Implications for Measurement and Prediction of Receiver Performance," IEEE Trans, EMC Vol, EMC-21, No. 3, August 1979.

11. "Feasibility Study--Noise and Its Relationship to Vehicle Electromagnetic Emissions," Bell Technical Operations Textron Report Number BTO 78-02-007, February 1978; USAEPG-FR-1065.

12. "Detailed Test Plan--Vehicle Noise Measurements," Bell Technical Operations Textron Report Number BTO 79-01-007, January 1979; USAEPG-TP-1065-3.

13. "Vehicle Noise Measurement Tests--Test Site Selection Plan," Bell Technical Operations Textron Report Number BTO 78-11-011, November 1978; USAEPG-TP-1065-2.

14. Matheson, R. J. "Instrumentation Problems Encountered in Making Man-Made Electromagnetic Noise Measurements for Predicting Communication System Performance," IEEE Trans. EMC, Volume EMC-12, pp 151-158, November 1970.

APPENDIX 1 - TEST VEHICLES AND COMMUNICATION SYSTEMS

1.1 TYPES OF VEHICLES

Commercial vehicles were used, because military vehicles were not available, except for the "Wheels" truck, which is a commercial vehicle adapted for military usage.

The test vehicles were powered by gasoline-fueled internal combustion engines. Table 1-I lists the vehicles with their identification numbers, number of cylinders, year, make, model, and mileage. As indicated, tests were conducted on eight-, six-, and four-cylinder vehicles from various manufacturers. The first vehicle listed is the "Wheels" truck, which was previously tested and used for comparison purposes (ref 4).

1.2 TYPES OF TACTICAL COMMUNICATION SYSTEMS

Performance tests were conducted on the communication systems listed in table 1-II. These systems cover the frequency range from 20 to 1000 MHz and use various forms of modulation/demodulation.

TABLE 1-I. DESCRIPTION OF VEHICLES TESTED

Vehicle No.	Identification (Serial) Number	Number of Cylinders	Year	Make	Model	Mileage
1	D24BE45001107	8	1970	Dodge *	D20 Pickup	79,782
2	9K92T154454	6	1979	Ford	Fairmont Sedan	4,397
3	9K92T154456	6	1979	Ford	Fairmont Sedan	3,464
4	A4A087368307	6	1974	American Motors	Hornet Wagon	54,345
5	GAECLU35442	4	1972	Ford Werke, AG	Capri Coupe	100,300
6	9K92T113319	6	1979	Ford	Fairmont Sedan	4,962
7	9K92T148909	6	1979	Ford	Fairmont Sedan	7,986
8	4R12Y127964	4	1974	Ford	Pinto Wagon	60,302
9	2X12X242946	4	1972	Ford	Pinto Wagon	89,812
10	9K92T101898	6	1979	Ford	Fairmont Sedan	7,270
11	A3A8572360317	8	1973	American Motors	Ambassador Sedan	95,806
12	A3A8572360323	8	1973	American Motors	Ambassador Sedan	79,386
13	Purdy's truck	8	1970	Chevrolet	C-30	74,500

*Wheels truck

TABLE 1-II. TACTICAL COMMUNICATION SYSTEMS AND CHARACTERISTICS

Systems	1	2	3	4
Nomenclature	AN/GRC-106	AN/VRC-12	AN/ARC-51	AN/GRC-103
Function	Tactical (Voice and Data)	Tactical (Voice and Data)	Air Traffic Control (Voice)	Tactical 12, 24 Channel (Voice and Data)
Deployment	Vehicles	Vehicles	Tactical Airfields	Tactical/Fixed Communications
Band and Frequency	MF/HF 2-30 MHz	VHF 30-76 MHz	VHF/UHF 225-400 MHz	UHF 695-1000 MHz
Modulation	SSB	FM	AM	FM/PCM
Performance Measure	AS, AI	AS, AI	AS, AI	AS, AI

APPENDIX 2 - MEASUREMENT INSTRUMENTATION

2.1 FIELD INSTRUMENTATION SETUP

2.1.1 NATE System Description

a. The Noise Automatic Test Equipment (NATE) system automatically monitors and records electromagnetic environmental noise data. The system is installed in a van, a configuration which permits the system to be easily transported to remote test sites.

b. The overall block diagram of the NATE system is shown in figure 2 in the main body of the report. The computer control portion of the system is an HP-9845A Desk Top Computer. The HP-9845A also, on completion of the APD run, provides a tabular and graphical printout of the measured data. The RF receiver consists of a balanced mixer, a programmable local oscillator, and tunable bandpass filters covering the frequency range 10-1000 MHz. The spectrum analyzer is an HP-8568A.

c. As mentioned above, the NATE system was configured for the specific purpose of the collection of near real time (NRT) electromagnetic environmental noise data. During the collection process, the data are verified and recorded automatically by the system. This is done through the use of prompting instructions generated by a computer program and supplied to the NATE operator via the cathode ray tube of the HP-9845A. Figure 2-1 has been expanded to include the component items of NATE. Table 2-I is a listing coded to figure 2-1 of these components with manufacturer's model numbers, serial numbers, calibration due dates, and appropriate remarks.

2.1.2 System Operation

a. The NATE system is sequenced and controlled by a program specifically designed for the vehicle noise measurement task. The program, contained on a prerecorded tape cassette/disk, is called VEHICL.

b. A flow diagram of the noise test as controlled by the "VEHICL" program is shown in figure 2-2. The HP-9845A as employed with the program accomplished the following:

(1) Using the prerecorded tape cassette/disk program as a source, the program was read into the computer memory.

(2) The test operator was prompted to select tape data output form required and to designate the test code.

(3) The display showed the test parameters for the particular subtest code under investigation and prompted the test operator to change the desired variable, if necessary (initial values of variables are assigned by the computer according to the test code selected). Such variables are vehicle (or vehicles) to be tested, the antenna separation, the test frequency, and the required RF bandwidth. The display prompted the operator to switch the NATE input to the calibrated noise source.

(Text continued on page 2-9)

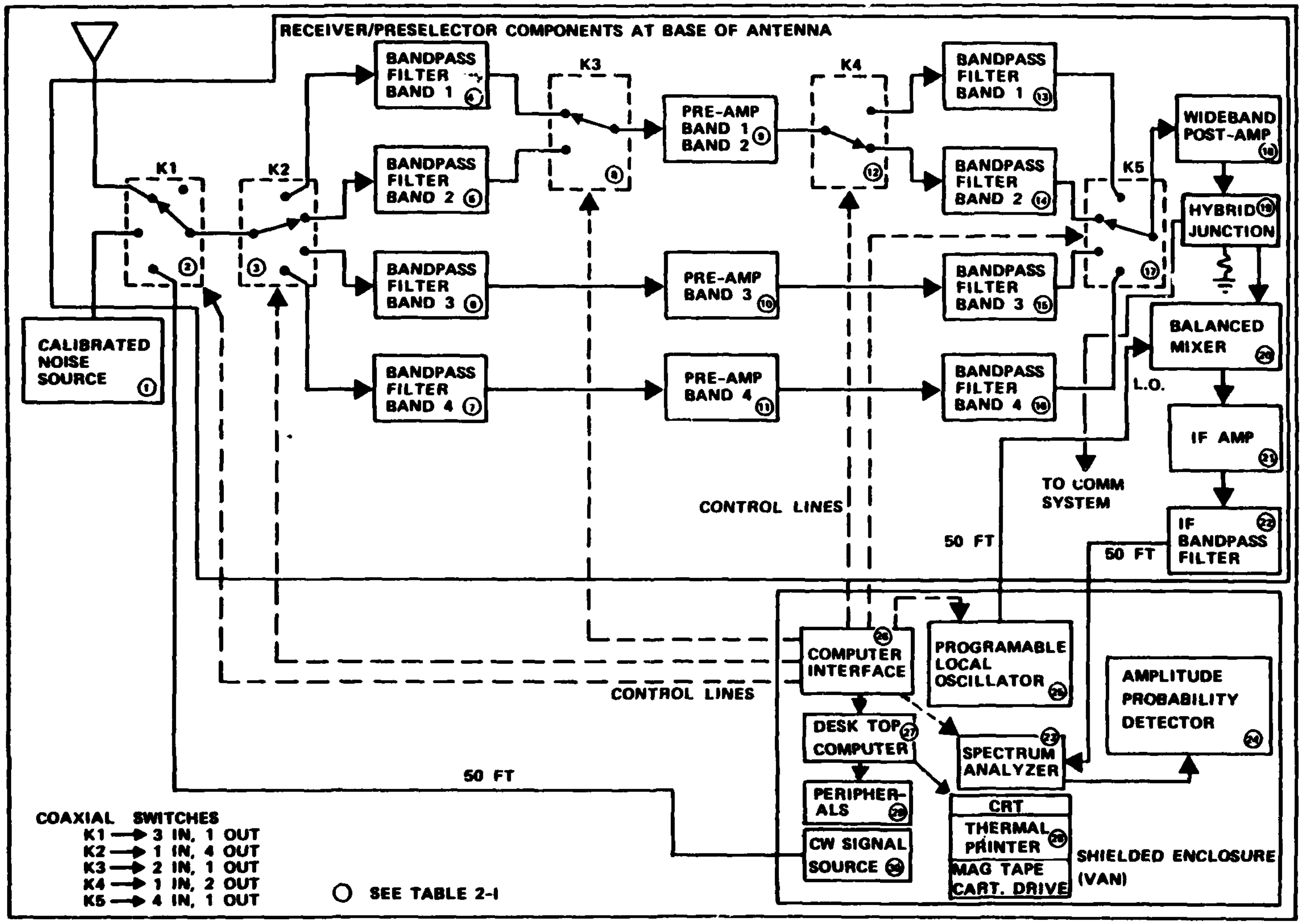


Figure 2-1. Detailed noise automatic test equipment (NATE) system block diagram.

TABLE 2-I DETAILED COMPONENT LIST FOR THE NATE SYSTEM

Figure Code No.	RF Receiver Component	Manufacturer	Model No.	Serial No.	Calibration Due Date	Remarks
1	Calibrated Noise Source	Microwave Semiconductor, Inc.	MC-1000	GM 211622	14 April 1980	Temperature range -55°C to 100°C
2	Coaxial Switch K1	Transco Products, Inc.	SA 4T	GM 20377	CNR	
3	Coaxial Switch K2	Transco Products, Inc.	SP 4T	GM 20370	CNR	
4.a.	Bandpass Filter, Band 1 (Low Pass)	Microphase	LP 30AB	SS 0601	8 April 1980	Center frequency, 30 MHz
4.b.	Bandpass Filter, Band 1 (High Pass)	Microphase	HT 20AP	SS 2790	8 April 1980	Center frequency 20 MHz
5	Bandpass Filter, Band 2	Telonic	TTF 95	SS 2611	12 March 1980	
6	Bandpass Filter, Band 3	Telonic	TTF 250	PM 15610	12 March 1980	
7	Bandpass Filter, Band 4	Telonic	TTF 750	SS 2617	12 March 1980	
8	Coaxial Switch K3	RLC Electronics	SR-T-N-D	PM 18838	CNR	
9	Preamplifier, Band 1 and Band 2	Avantek	UA 142	NA	NA	Frequency range, 20 to 100 MHz
10	Preamplifier, Band 3	Avantek	UA 143	NA	NA	Frequency range, 100 to 500 MHz
11	Preamplifier, Band 4	Avantek	UA 441	NA	NA	Frequency range, 500 to 1000 MHz
12	Coaxial Switch K4	RLC Electronics	SR-T-N-D	PM 18857	CNR	NO/NC
13a.	Bandpass Filter, Band 1 (Low Pass)	Microphase	LP 30AB	SS 0571	8 April 1980	Center frequency, 30 MHz
13b.	Bandpass Filter, Band 1	Microphase	HT 20AB	SS 2789	8 April 1980	Center frequency, 20 MHz

CNR = Calibration not required

NA = Not available

Figure Code No.	RF Receiver Component	Manufacturer	Model No.	Serial No.	Calibration Due Date	Remarks
14	Bandpass Filter, Band 2	Telonic	TTF 72	PM 15896	12 October 1980	
15	Bandpass Filter, Band 3	Telonic	TTF 250	SS 2614	12 October 1980	
16	Bandpass Filter, Band 4	Telonic	TTF 1000	SS 2618	12 October 1980	
17	Coaxial Switch K5	RLC Electronics	SR-5-N-D	PM 18716	CNR	
18	Wideband Post Amplifier	Hewlett-Packard	8447E	NA	CNR	Frequency range, 0.1 to 1300 MHz
19	Hybrid Junction	Anzak Electronics	H-9	SS 3147	10 July 1980	Frequency range, 2 MHz to 2 GHz
20	Balanced Mixer	Anzak Electronics	ASM-115	PM 10203	10 July 1980	
21	IF Amplifier	Avantek	UA 142	NA	NA	Frequency range, 20 to 100 MHz
22	IF Bandpass Filter	Allen Avionics	F 829	GM 21136	11 March 1980	Center frequency, 21.4 MHz
23	Spectrum Analyzer	Hewlett-Packard	8568 A	GM 21162	7 April 1980	Frequency range, 100 Hz to 1.5 GHz
24	Amplitude Probability Detector	USAEPG	NA	GM 20995	NA	
25	Programmable Local Oscillator	Hewlett-Packard	8660 C	NA	NA	Operating frequency 21.4 MHz
26	Computer Interface (Party Line System)	CDS	53A	GM 21054	CNR	
27	Desktop Computer	Hewlett-Packard	9845A	GM 21104	CNR	Includes CRT, thermal printer, and 2 magnetic tape cartridge drives

CNR = Calibration not required

NA = Not available

Figure Code No.	RF Receiver Component	Manufacturer	Model No.	Serial No.	Calibration Due Date	Remarks
28	CRT, Thermal Printer, and 2 magnetic tape cartridge drives	Hewlett-Packard	9845A	GM 21104	CNR	Installed as part of the model 9845A desktop computer
29	Peripherals	Hewlett-Packard				
	a. Paper tape punch		9884A	GM 201107	CNR	
	b. Floppy disc drive		9885M	GM 21149	CNR	
30	CW Signal Source	Hewlett-Packard	8660C	NA	NA	

CNR = Calibration not required

NA = Not available

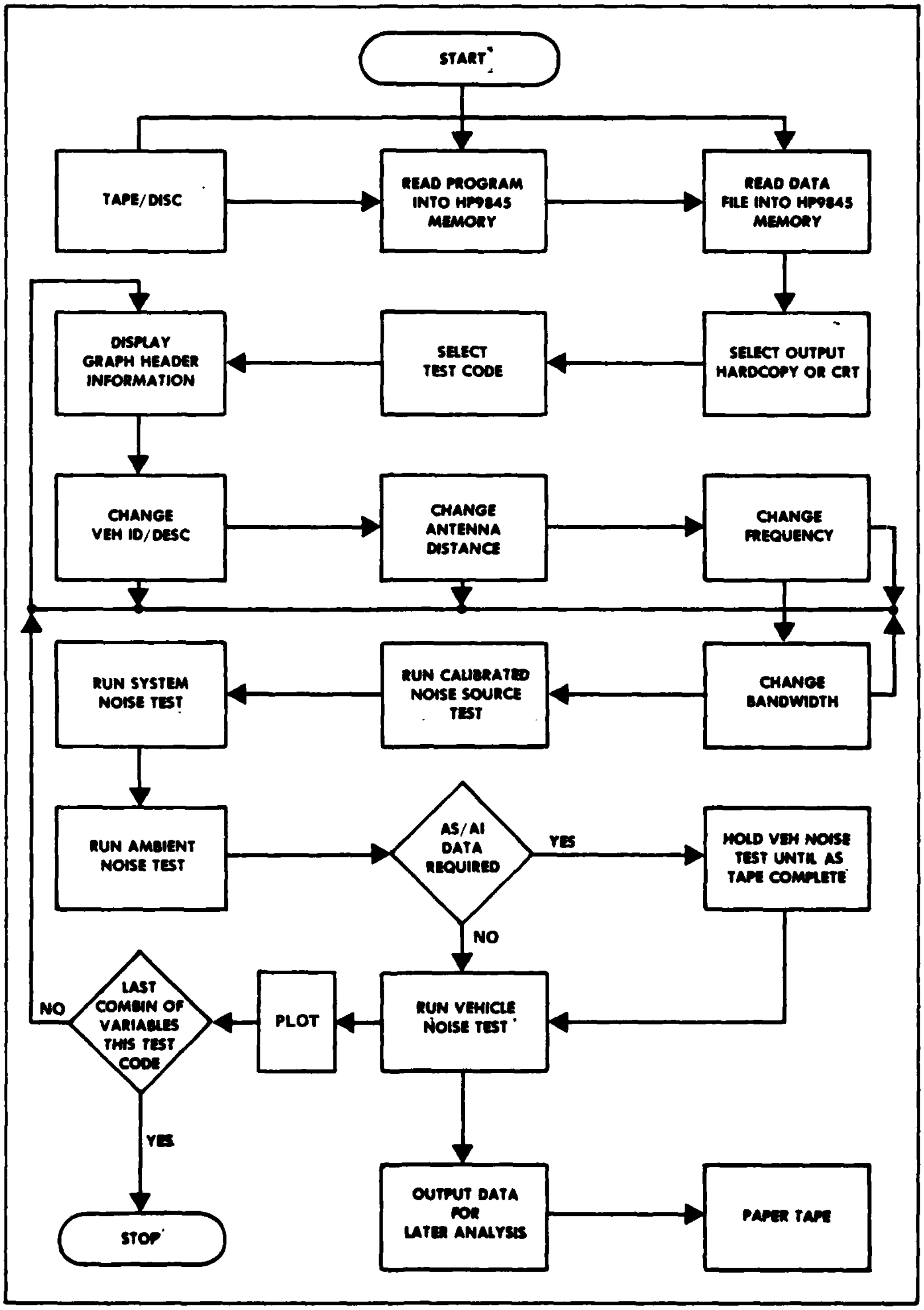


Figure 2-2. Noise test flow diagram.

(4) The operator initiated the noise calibration APD test and the data were stored in the computer. The noise source was switched off, and the NATE input was terminated in its characteristic impedance.

(5) The operator initiated the system noise test, and the data were stored in the computer. The input termination was removed, and the test antenna was automatically connected.

(6) The operator initiated the ambient noise test (vehicles not running), and the data were stored in the computer.

(7) Operator determined from test plan whether AI/AS tests were to be run on one of the communication systems. If so, the communication system was started, the vehicle (or vehicles) were started, and the AI/AS tests were made, and controllable vehicular noise was injected into the communication system. The received audio signals were recorded for AS determination by crews of trained listeners.

(8) In the event that AI/AS tests were not conducted, step 15 was not performed and the test proceeded. With the vehicles running, the vehicular noise test was initiated by the test operator and the data stored in the computer memory.

(9) The complete test data for this subtest were stored for later analysis and/or could be plotted for immediate analysis.

2.2 CALIBRATION

2.2.1 Introduction

Calibration tests were performed on the NATE system. Three types of tests were conducted. The first, the noise figure test, established that the NATE receiver was functioning as planned. The second, the continuous wave (CW) test, was made as each shift of testing was begun and demonstrated that the NATE system was functioning uniformly. The third, the Gaussian noise calibration, was made as part of each vehicle noise test, and the measured value was printed on each data sheet. Calibrated antennas were used with the NATE to measure the vehicular noise.

2.2.2 Description of Calibration Tests

a. Noise Figure test

This test was conducted to determine that the NATE receiver would perform its intended function. The steps in the measurement are as follows:

(1) The "Y-Factor" method shown in figure 2-3 was used to provide noise figure (NF) data as a function of frequency and bandwidth.

(2) The calibrated Gaussian noise source was connected directly to the NATE receiver. This source was not energized, that is, operated in the "cold" position.

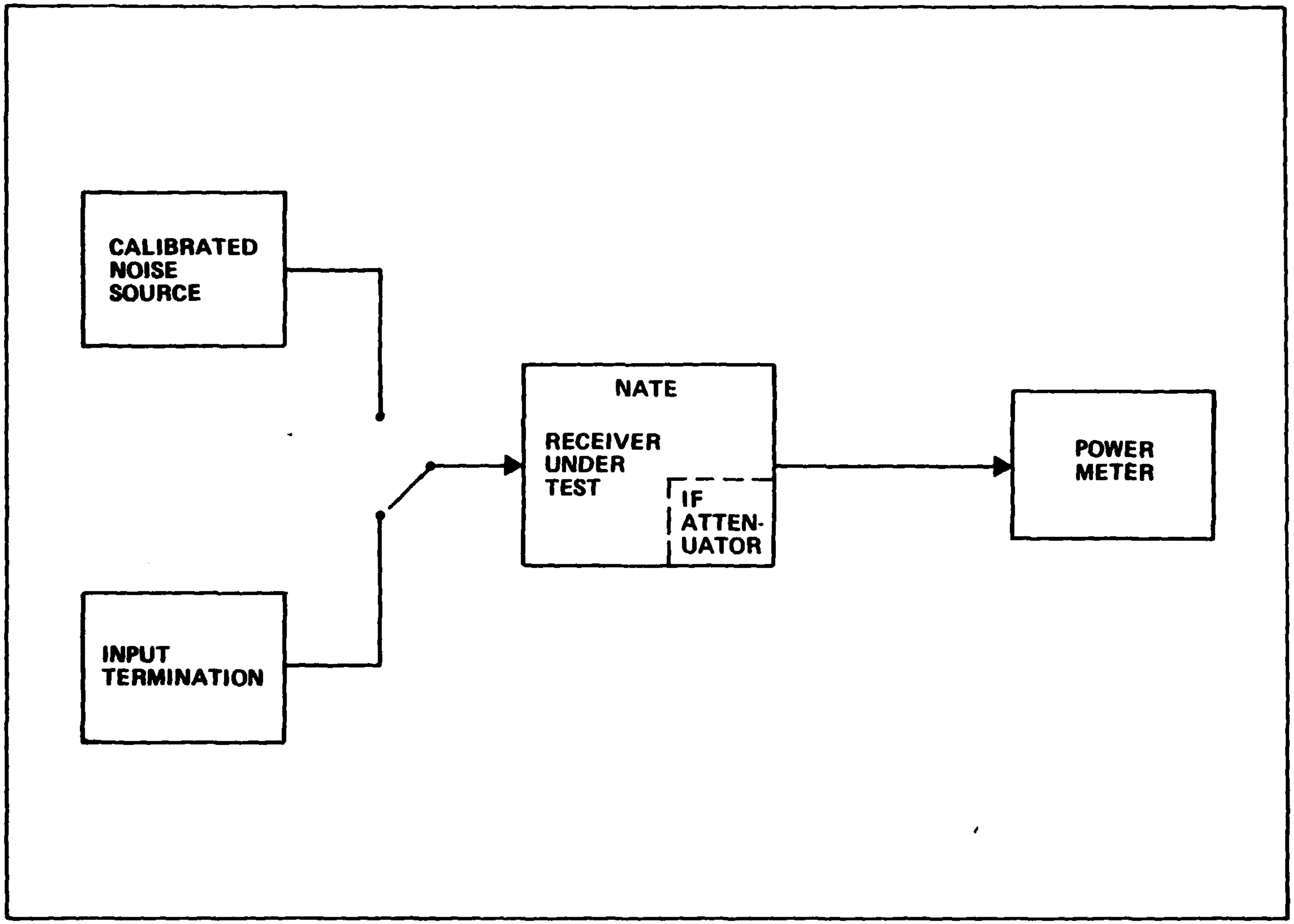


Figure 2-3. The "Y factor" method of noise figure measurement.

(3) The NATE receiver was energized and tuned to 23 MHz, and the resolution bandwidth and video bandwidth of the spectrum analyzer were set to 3 kHz.

(4) The power detector was set to a convenient reference level. The level was recorded.

(5) The noise source was energized.

(6) The IF attenuator setting was increased until the power detector reference point was reached. The value of the noise source (35 dB) minus the value of the IF attenuator setting constituted the NATE noise figure and was recorded.

(7) Procedures (1) through (6) were repeated for each receiver tuned frequency; that is, 75 MHz, 300 MHz, and 900 MHz, and for spectrum analyzer resolution and video bandwidths as shown in table 2-I.

b. Continuous-Wave Test

This test was made to determine that the NATE system performance had not deteriorated during the previous shift. It was made by the incoming test crew.

(1) The CW source was located in the NATE van.

(2) The CW source had an output impedance of 50 ohms and a frequency range of 10 MHz to 1 GHz.

(3) A fixed level (-110 dBm) at 23 MHz was connected to the NATE antenna terminal.

(4) The spectrum analyzer was set to 10-kHz bandwidth, 1-MHz span, and a scan trace of 20 milliseconds.

(5) The indicated level on the spectrum analyzer was noted and compared with previous readings.

(6) The above cycle of testing was repeated for 75, 300, and 900 MHz.

c. Gaussian Noise Calibration

This test was conducted to provide an individual noise calibration for each APD noise test.

(1) The calibrated noise source provided an excess noise ratio (ENR) of 35 dB relative to thermal noise at 290° Kelvin ($ENR = 35$ dB $> kT_o b$), for a frequency range of 10 MHz to 1.5 GHz, with the output flat within ± 0.5 dB.

(2) The noise source was connected at the NATE antenna terminal as shown in figure 2-1 at the start of vehicular APD test.

TABLE 2-I. NATE RECEIVER NOISE FIGURE (NF) TEST DATA SHEET: TEST DATA

Page___of___

Date/Time: ________________ Test Personnel: ________________

Type of Test: ________________

RF Tuned Frequency, MHz	IF Bandwidth, KHz	Video Bandwidth, KHz	Power Detector Relative, -dBm	Source ENR, dB	IF Attenuator Value, dB	Noise Figure, dB
23	3	3	-35.5	35	32	3
23	10	10	-33.7	35	32	3
23	30	30	-32.1	35	32	3
75	3	3	-36.0	35	32	3
75	10	10	-34.1	35	32	3
75	30	30	-32.5	35	32	3
75	100	100	-31.1	35	32	3
75	300	300	-60.1	35	32	3
300	10	10	-64.8	35	29	6
300	30	30	-63.1	35	29	6
300	100	100	-61.6	35	29	6
300	300	300	-60.5	35	29	6
900	100	100	-62.7	35	28	7
900	300	300	-61.5	35	28	7

(3) The NATE operational frequency and bandwidth were selected for the previously established test codes (see tables II and III).

(4) Then an APD test was conducted and the calibrated rms noise level was measured and stored in the computer along with the vehicular noise data. The calibrated noise source with an ENR = 35 dB > $KT_o b$, therefore, provided a measurement reference for the NATE system and verified accurate system operation.

(5) After the conclusion of the APD test, the data, including the calibrated rms noise level, were printed in the standard format shown in the example of figure 6 by the HP-9845's automatic printer/plotter.

(6) The calibrated rms noise level, as measured by the NATE system, is given under the column heading Cal. RMS. As shown in the example of figure 6, the value measured was 52.6 dB(μV). Using figure 7 and noting that the measured values of rms voltages as stated in the standard formatted table (see figure 6) include a IF gain factor of 40 dB, the calibrated noise level can be verified to be the quantity 35 dB > $KT_o b$. Applying figure 7 and the IF gain factor results in 52.6 dB(μV) - 40 dB + 67 dB - 10 log (30 kHz) $\simeq$ 35 dB > $KT_o b$ where 6 is the spectrum analyzer bandwidth of 30 kHz.

2.2.3 Description of Calibrated Antennas

Three different calibrated antennas were used in the vehicular noise tests. The calibration on each antenna was provided by the manufacturer documentation. The antennas are shown in the following table together with the antenna factors for each. The antenna factor is a value given in dB, which, when added to the voltage (in dBV) at the receiver input terminal, will provide the electric field strength at the antenna in dBV/m.

Antenna Type	Antenna Factor			
	23 MHz	75 MHz	300 MHz	900 MHz
Biconical	11.6	7.6	N/A	N/A
Log Periodic	N/A	-1.6	22.4	32.0
Dipole	N/A	N/A	17.9	27.5

N/A = Not used at this frequency

2.3 ARTICULATION SCORING

2.3.1 Scoring of Voice Communications Equipment

a. The determination of the performance of a voice communications link requires the evaluation (scoring) of the audio output of the link under conditions of controlled interference. This is accomplished by monitoring the audio

output to determine the effect of various signal-to-interference ratios (S/I) on the quality of this output. Two types of scoring are generally used for this type of analysis: the articulation index (AI), which is a numerical output from an electronic analyzer; and the articulation score (AS), which is determined by a human operator.

b. AI is a derived measure of intelligibility based on weighted S/I in several audio frequency bands of equal intelligibility contribution. AI is measured by means of an electronic analyzer that outputs a score from 0 to 1.0 as a measure of the quality of a test tone sent over the test link. If no degradation to the test tone exists, the analyzer assigns an AI of 1.0; and if the test tone is completely masked by interference, the analyzer assigns an AI of 0. The AI, monitored and recorded during the conduct of the test, becomes a record of the effect of each interference condition on the voice link.

c. The AS is a measure of the percentage of phonetically balanced words in a test message correctly scored by a team of trained listeners. In practice, team members listen and respond to recordings of the test message derived from the ouptut of a test link into which interference has been introduced. Team subjects are screened to eliminate those whose hearings characteristics are nonrepresentative of the norm and trained on a series of tape messages for which standardized scores exist. The purpose of this training is to "calibrate" the response of each team member. Phonetically balanced words are used in the test message so as to be representative of English language sounds. The test message, consisting of word-group recordings, each containing 50 monosyllabic words per group mixed with interfering signals, is played to the listeners and their response is observed. Upon hearing a word, each listener presses a button on his console corresponding to the word he thinks he hears. After all listeners have responded, the responses are automatically recorded on punch cards for subsequent computer processing. The final result is the AS. The system insures against the memorizing of word lists by using each team member for only short periods of time with at least a year between each period of duty. The system provides for the evaluation of test links under closed-link conditions in a workshop, or recordings taken at remote sites under field conditions may be evaluated at the listener facility.

d. For communications equipment that has no previous testing history, it may be necessary to establish a correlation between the AI and AS values. This correlation provides a check of the performance of the equipment, in terms of effect on a human operator's understanding, at various AI and S/I levels. To accomplish this, tape records at specific S/I levels are scored by listener teams to obtain the corresponding AS values. It has been found that an AI score of 0.3 generally represents 50-percent intelligibility (AS), and an AI score of 0.7 represents a signal that is nearly 100-percent intelligible.

2.3.2 Voice Interference Analysis System

a. The Voice Interference Analysis System (VIAS) provides an automated means of scoring analog (voice) communications links by electronic measurement techniques. The output of the VIAS is a numerical value called articulation index. The articulation index is directly correlatable to the articulation scores obtained by trained listeners in the Scoring Facility.

b. In the VIAS method of computation, the speech frequency spectra between 200 and 6100 Hz are divided into 14 equally contributing bands. The signal-to-noise ratio (S/N) in each band is determined. This ratio is expressed log-arithmically on a scale where unity (fully contributing to speech intelligibility) corresponds to an S/N of 18 dB. Ratios above or below these values are rated as unity or zero, respectively. The individual band contributions are summed and divided by 14. The result is the articulation index. Speech power in any given band contributes as much to the total articulation index as the speech power in any other band. The bandwidth of each of the 14 bands is carefully chosen to permit the articulation index calculation to be made.

c. No speech is actually transmitted in the VIAS. Instead, a modulated pilot tone located near the peak of the normal speech spectrum is used to provide a reference level. Because the shape of the speech spectrum is known, the levels of speech can be directly inferred for the machine calculation.

d. Initially, the set-level tone (an unmodulated 950-Hz tone) is adjusted to the audio level at the input to the transmitter-to-receiver, voice-modulated ratio link under test. The standard VIAS test signal is then applied for system measurement. The operate signal, a 950-Hz tone triangularly amplituded-modulated at 5 Hz, modulates the transmitter. The average output level of the operating waveform corresponds to the average power of the speech waveform. The output voltage of a receiver under test includes components of the pilot tone which represent the speech output and noise components related to the interference.

e. A filter then separates the pilot tone components from the noise components. The tone provides a slowly varying direct current which controls the gain of the log amplifier. Because the 950-Hz pilot tone has been removed by filtering, the actual output of the log amplifier is the noise component of the received signal. The gain of the amplifier is being controlled by the 950-Hz reference, and therefore the noise amplitude is proportional to the signal-to-noise ratio.

f. Two shaping networks weigh the frequency distribution of the noise in a manner inversely proportional to the method used with the normal speech spectrum. Thus, at this point in the system, the noise spectrum level at any frequency is made proportional to the noise-to-speech ratio for the same frequency at the input to the system under test.

2.4 AMPLITUDE PROBABILITY DETECTOR

a. The amplitude probability detector is an instrument that provides the following statistical data: amplitude probability distribution (APD), average crossing rate (ACR), average voltage (V_{av}), and root-mean-square voltage (V_{rms}) of an input signal waveform. The operational modes of the instrument are: (a) a manual mode, which permits measurements of a threshold level corresponding to a single preset probability; (b) an automatic mode, which sequentially measures the levels for all preset probabilities; and (c) a remote mode, which permits total remote control and automatic data retrieval. The instrument has an internal calibrator with an upper and lower point that references the amplitude scale in dB to input signal level range (window).

b. The prinicipal function of the amplitude probability detector is to provide the APD of an input signal waveform. This is done by determining whether the waveform exceeds some threshold level with a selected probability for some test time. The instrument functions through the use of a threshold level generator, a threshold detector, two pulse trains, and an up/down counter. Test time can be set to 0.5, 1, or 5 seconds. The probability levels which can be selected are 0.0001, 0.0005, 0.001, 0.01, 0.02, 0.05, 0.1, 0.2, 0.3, and 0.4. The instrument measures the threshold level for a specific probability within a voltage window established during the self-calibration cycle. This window can be adjusted so that there is a prescribed number of levels within the window; for example, 100 levels in the 0- to 1-volt range. When the test cycle is initiated, the probability function in the amplitude probability detector is set either automatically or manually to any one of the ten values specified in the preceding. The device will then, beginning at the upper calibration point, and under software control, cause this level to decrease sequentially while sampling the input signal. This process will continue until the probability level matches the preset probability (frequency of occurrence) associated with some level of the input signal.

c. The instrument also measures the ACR by determining the average number of positive crossings of an input signal with respect to a given threshold during the test time. In addition to measuring APD and ACR, another set of circuits samples and digitizes the input signal waveform. The digital representation is then used to calculate the V_{av} and V_{rms} of the waveform.

APPENDIX 3 - DATA ANALYSIS AND RESULTS

APPENDIX 3 - DATA ANALYSIS AND RESULTS

3.1 WEIBULL DISTRIBUTION AS APPLIED TO VEHICULAR NOISE DATA

3.1.1 Basic Relationships

The raw data plots of the amplitude probability distribution (APD) function (see appendix 5) showed that two straight lines could be fitted very closely to the data when the threshold envelope level, in dB re rms, was plotted against an X-axis proportional to $-\log\,[-\ln\,(\text{Probability})]$. These findings were expected, based on prior test results (ref 6). Such a straight line fit implies that, within a region of applicability,

$$R = a\left(-\log\,[-\ln\,P(R)]\right) + b \tag{3-1}$$

where R is the threshold level in dB(μV) at an exceedance probability P(R), with a as the slope of the line and b as the intercept. If we define

r = threshold envelope level in μV

$$a = -\frac{20}{m}$$

$$b = aK/10$$

with $K = 10 \log k$

then $R = 20 \log r = 10 \log r^2$

$$= \frac{2}{m}\,[10 \log\,(-\ln P) \;\; - K] \qquad [\mathrm{dB}(\mu\mathrm{V}) \tag{3-2}$$

or $10 \log\,[-\ln P(R)] = \frac{m}{2}\,R + K = 10 \log\,[k(r^2)^{m/2}]$ (3-3)

thus $-\ln P(r) = kr^m$

and $$P(r) = \exp\left\{-kr^m\right\} \tag{3-4}$$

If the APD plot consists of but one straight line, so that the equation is good for all $r \geq 0$, then the probability density function of r is given by:

$$p\,(r) = -\frac{dP(r)}{dr} \qquad (r \geq 0)$$

$$= kmr^{m-1} \exp\left\{- kr^m\right\} \quad (r \geq 0) \qquad (3\text{-}5)$$

This is a well-known form, called the Weibull probability density function with parameters m and k. It has several interesting properties. For example, if m = 2 and k is redefined as $(2\sigma^2)^{-1}$, then

$$p_r(r) = \frac{r}{\sigma^2} \exp\left\{- \frac{r^2}{2\sigma^2}\right\} \qquad (3\text{-}6)$$

which is known as the Rayleigh probability density function. The moments of the distribution also have an interesting property. The n^{th} moment is given by

$$E[r^n] = \int_o^\infty r^n\, p(r)dr$$

$$= \int_o^\infty r^n kmr^{m-1} \exp\left\{-kr^m\right\} dr \qquad (3\text{-}7)$$

If we let

$$t = r^m$$

$$dt = mr^{m-1}\, dr$$

then $r^n = t^{n/m}$

and $$E[r^n] = k\int_o^\infty t^{n/m} \exp\left\{-kt\right\} dt \qquad (3\text{-}8)$$

With $z = 1 + n/m$,

$$E[r^n] = k^{-n/m}\left\{k^z \int_o^\infty t^{z-1} \exp[-kt]\, dt\right\}$$

$$= k^{-n/m}\, \Gamma(z)$$

$$= k^{-n/m}\, \Gamma\left(1 + \frac{n}{m}\right) \qquad (3\text{-}9)$$

where $\Gamma(\cdot)$ is the gamma function.

Taking 10 times the log of both sides gives

$$10 \log \; E[r^n] = -\frac{n}{m} K + 10 \log \left[\Gamma(1 + \frac{n}{m})\right] \tag{3-10}$$

Of special interest is the case where n = 2. Then the mean squared envelope value in dB terms is:

$$10 \log \left(E[r^2]\right) = -\frac{2}{m} K + 10 \log \left[\Gamma(1 + \frac{2}{m})\right] \tag{3-11}$$

and since

$$V_{rms} \triangleq 20 \log \left(E[r^2]\right)^{1/2} \tag{3-12}$$

$$V_{rms} = -\frac{2}{m} K + 10 \log \left[\Gamma(1 + \frac{2}{m})\right] \quad [dB(\mu V)] \tag{3-13}$$

The threshold level in dB re rms for a given probability P is given by [combining equations 3-2 and 3-13]:

$$R - V_{rms} = \frac{20}{m} \log \left[-\ln P\right] - 10 \log \left[\Gamma(1 + \frac{2}{m})\right] \tag{3-14}$$

Equations 3-2, 3-13, and 3-14 are very important when applying the Weibull distribution to vehicular noise data, as in this study. Equation 3-2 is easy to solve with a hand calculator, but 3-13 and 3-14 involve the gamma function, which is difficult to work with without a computer. Therefore, nomograms of these latter equations are provided in figures 3-1 and 3-2.

3.1.2 Separating APD Plots into Vehicular and Ambient Components

A receiver always has a background level of receiver noise. When the receiver is connected to an antenna, the signal in the IF becomes the sum of receiver noise and whatever other signals may be present. The envelope of the IF signal is a composite of the various signals and internal receiver noise. In this study, we use the adjective ambient to describe the composite envelope signal when no test vehicle is turned on. Thus, the ambient signal is receiver noise plus whatever other man-made, atmospheric, or galactic noise may be present. If receiver noise dominates over the other ambient noises, the ambient

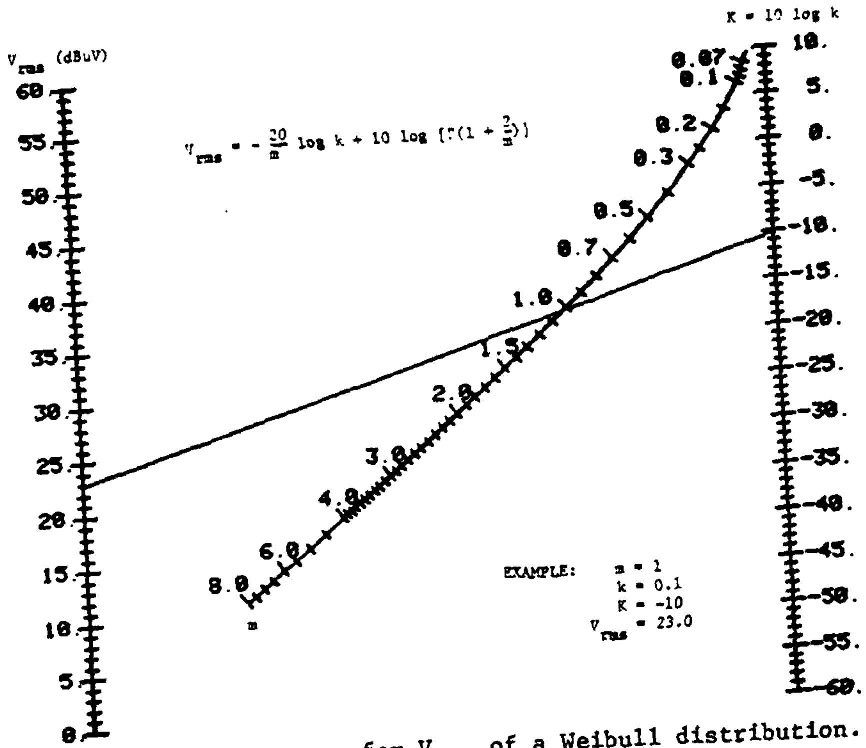


Figure 3-1. Nomogram for V_{rms} of a Weibull distribution.

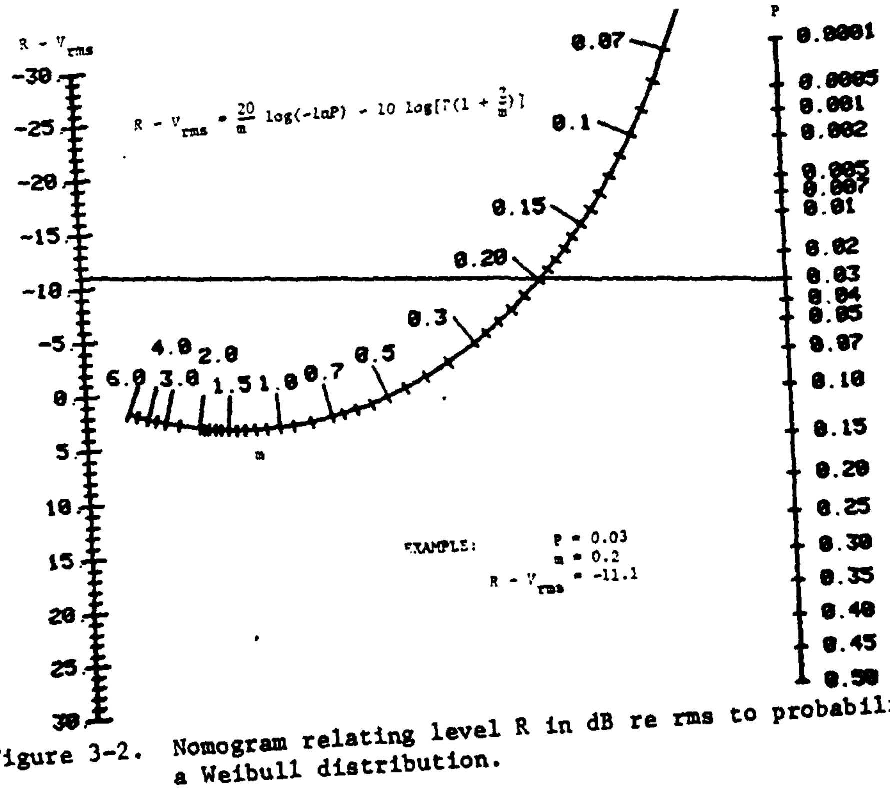


Figure 3-2. Nomogram relating level R in dB re rms to probability for a Weibull distribution.

noise is Gaussian; if the converse is the case, the ambient may be very non-Gaussian. The latter was found to be the case in many tests of this study. If vehicular noise is present, it provides an added component to the IF signal. If the receiver is operating linearly, these various components are additive in a mean-square sense. That is, the mean-square composite signal equals the sum of the mean-square value of the various components.

In nearly every case, the APD plots of this study showed a very sharp transition in slope when vehicular noise was present. This suggested the possibility of assigning the higher level, low-probability portion of the plot entirely to the vehicular component and the lower level, high-probability portion entirely to the ambient. See figure 3-3 for a sample plot. In the figure, piecewise linear regression techniques have been used to fit the straight lines, which, as discussed in 3.1.1 above, imply Weibull m and k parameters. In the example shown,

$$m_a = 1.763 \qquad K_a = 10 \log k_a = -20.08$$

$$m_v = 0.258 \qquad K_v = 10 \log k_v = 1.706$$

where a and v subscripts are used to indicate applicability to the ambient and vehicular regions.

From the two sets of m and k values, equation 3-13 was used to calculate hypothetical envelope rms components V_a and V_v. The values are hypothetical, because the actual envelope is due to a nonlinear composite of the ambient and vehicular IF components. However, these hypothetical components imply ambient and vehicular mean-square levels in the IF, because the mean-square envelope value is twice the mean-square value of the IF for an ideal, 0-dB gain envelope detector. The proof of this follows easily from

$$E\left[v_{IF}^2\,(t)\right] = E\left[r^2(t)\ \cos^2\left(\omega_{IF}t + \phi(t)\right)\right]$$

$$= E\left\{\frac{r^2(t)}{2}\cdot\left[1+\cos\left(2\,\omega_{IF}t + 2\phi(t)\right)\right]\right\} \qquad (3\text{-}15)$$

where $r(t)$ = envelope function

$\phi(t)$ = phase function

It follows, therefore, that V_{rms} of the composite envelope should be given, to a close approximation, by

$$V_{rms} = 20 \log \left[E[r^2]\right]^{1/2} = 10 \log \left[E[r^2]\right]$$

$$V_{rms} = 20 \log v_{rms} = 10 \log \left(10^{V_a/10} + 10^{V_v/10} \right) \qquad (3\text{-}16)$$

where v_{rms} is the composite envelope root mean square in microvolts.

The equation is only approximate because:

(1) There is undoubtedly some interaction between the vehicular and ambient components near the region of intersection on the APD plots, and

(2) at very high levels (low probabilities) the APD curve must bend over from the straight line of the Weibull fit.

Factor 2 can be very important and lead to significant errors when m is very small. This can be seen from the nomogram in figure 3-2, which shows that for $m < 0.09$ the bulk of the rms noise is provided by noise levels at probability levels below 0.0001.

A full set of m_a, K_a, V_a, m_v, K_v, and V_v values fitted to the test data is given in section 3-4. In the table, the "raw data fit" values are given on the first of two paired lines. The second line, the "adjusted" line, has values after the process of pivoting has been applied (see para 3.1.3, following). The table entries on the first line under the heading "VTRMS" are the measured V_{rms} values in dB(μV). Also given are the threshold level and probability at the point where the lines intersect. Asterisks beside a V_{rms} entry indicate that the measured V_{rms} was less than V_a. This represents an error case. In all cases where this occurred, the amount of error was within reasonable tolerances for experimental error for the two ways of measuring levels in the APD analyzer. A value of $m_a = 999.99$ is used to flag cases where the slope of the ambient line was zero, implying an infinite value of m.

The point of intersection of the vehicular and ambient lines is found as follows:

Let $X = -10 \log (-\ln P)$ (3-17)

so that X is proportional to linear distance along the X-axis of the APD plot. Then by equation 3-2, intersection occurs when

$$R_I = -\frac{2}{m_a} (X_I + K_a)$$

$$= -\frac{2}{m_v} (X_I + K_v) \qquad (3\text{-}18)$$

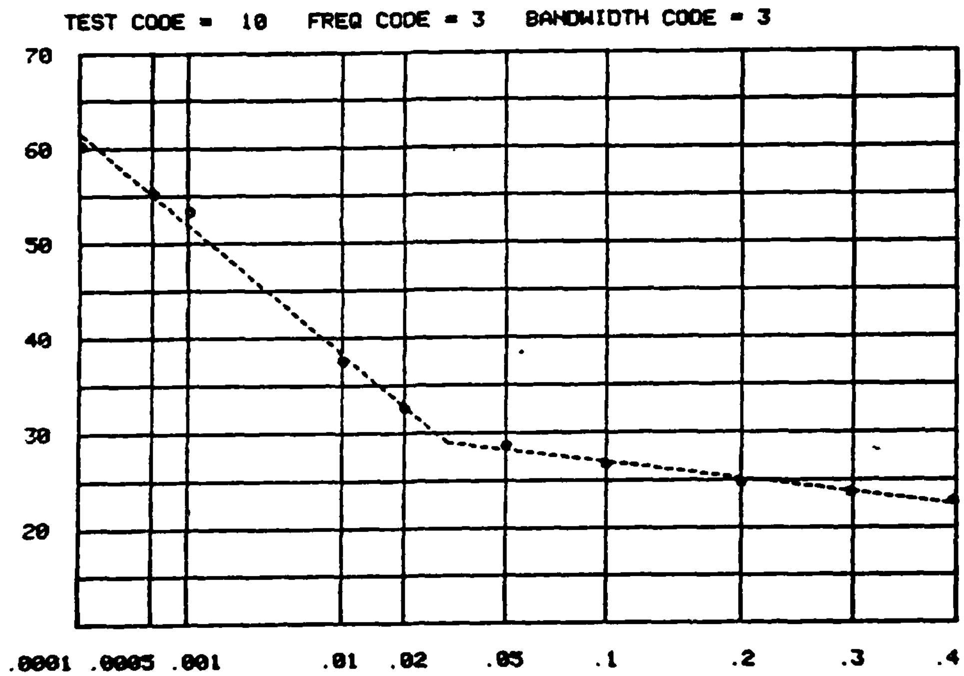


Figure 3-3. APD versus probability.

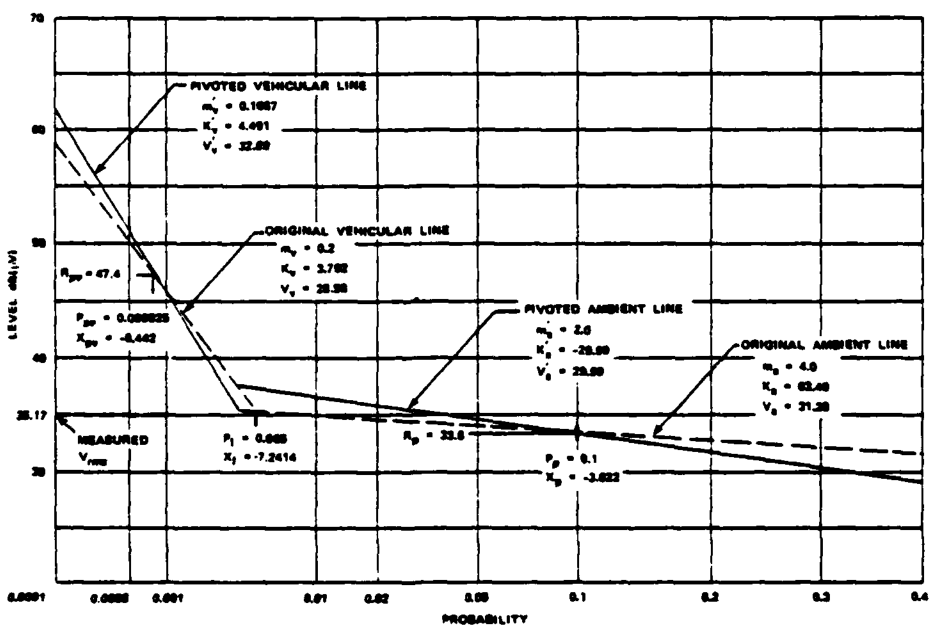


Figure 3-4. Example of pivoting APD lines.

where the I subscript refers to values at the point of intersection. Solving for X_I gives:

$$X_I = \frac{K_a m_v - K_v m_a}{m_a - m_v} \tag{3-19}$$

whereupon R_I can be found from equation 3-18. The probability at intersection is, from equation 3-17,

$$P_I = \exp \left\{ - 10^{-X_I/10} \right\} \tag{3-20}$$

The m and K values in this report were determined by least-squared regression equations. However, "eyeball" fits of straight lines to APD data can be used to provide reasonably good estimates of m and K by the following simplified technique [which is easily derived from equation 3-2]:

1. Plot threshold levels in dB(μV) versus probability, where the P axis is scaled by $X = -10 \log (-\ln P)$, as seen in the figures of this appendix.

2. Using engineering judgment, draw straight-line approximations to the ambient and vehicular regions.

3. Pick two points, (P_1, R_1) and (P_2, R_2), on each segment.

4. Estimate each segment's m and K parameters by:

$$m = \frac{20 \left[\log (-\ln P_1) - \log (-\ln P_2)\right]}{R_1 - R_2} \tag{3-21}$$

$$K = -\frac{m}{2} R_1 + 10 \log (-\ln P_1) \tag{3-22}$$

5. Then, if Weibull parameter K is desired:

$$k = 10^{K/10} \tag{3-23}$$

(But the logarithmic parameter k is usually easier to work with.)

3.1.3 Pivoting the APD Component Lines

The m and K values estimated from measured data are obviously subject to some error. If we make use of available a priori knowledge, we should be able, in some cases, to come up with better estimates than those provided by least-squared error regression techniques. As a case in point, it is well known that Gaussian noise at IF yields a Rayleigh distributed envelope function, which, as stated in equation 3-6, is a Weibull distribution with parameter $m = 2$. Since receiver noise is Gaussian, one would expect that at higher frequencies, where man-made noise (other than measured vehicular noise) on a clear channel and atmospheric noise are negligible, the Gaussian case, with a Rayleigh "slope parameter" of $m_a = 2$, should predominate.

Using the above rationale, ambient component APD lines with $m_a \approx 2$ were adjusted to yield lines that had a "Rayleigh slope," i.e., $m_a = 2$. Note that the actual slope of level R versus $X = -10 \log (-\ln P)$ is $-2/m_a$ (see equation 3-2). To ensure that changing m_a from the value determined by the least-squared error fit to measured data to $m_a = 2$ did not grossly contradict the measured results, two criteria were employed:

(1) The measured slope had to be within 20 percent of the Rayleigh slope, i.e., $-2/m_a = -1 \pm 0.2$,

(2) the altered line had to pass through the midpoint of the data over which the least-squared regression line was estimated, i.e., at a point on the X axis of $X_p = 0.5 \, [X_I - 10 \log (-\ln 0.4)]$ where, as above, X_I is the intersection of the vehicular and ambient lines.

With some thought, it is apparent that the altering of m to the Rayleigh case of $m_a = 2$ means pivoting the ambient line on the APD plot about the point (R_p, X_p), where X_p is as given above and R_p is the threshold level predicted from a least-squared error linear regression of the measured data, with R_p given by equation 3-2:

$$R_p = -\frac{2}{m_a} (X_p + K_a) \quad . \tag{3-24}$$

An example of the pivoting process may be seen in figure 3-4. The figure is for example only, because the slope of the ambient line differs greatly from the Rayleigh slope.

Vehicular component APD lines were similarly pivoted, based on the a priori knowledge of the measured mean-squared composite value, and the deduced ambient component--again with certain restrictions, so that measured data would not be grossly violated. The a priori knowledge is that

$$V_v' = 10 \log \left(10^{V_{rms}/10} - 10^{V_a/10}\right) \qquad (3\text{-}25)$$

which follows directly from the property of additivity (in a mean-squared voltage sense) of vehicular and ambient components in the IF (equation 3-16).

The prime on V_v' is used to indicate the theoretical value, based on the measured composite V_{rms} and the deduced ambient component. New values of m_v and K_v were sought which would make V_v, given by equation 3-13, equal to V_v' and have the APD line pass through the point (X_{pv}, R_{pv}),

where:

$$X_{pv} = 0.5 \left[X_I - 10 \log (-\ln 0.0001)\right] \qquad (3\text{-}26)$$

$$R_{pv} = -\frac{2}{m_v} (X_{pv} + K_v) \qquad (3\text{-}27)$$

Once again, the amount of pivoting was restricted to a 20-percent maximum change in slope, and was only done when V_{rms} exceeded V_a by at least 1 dB, so that a reasonably good estimate of V_v' could be made.

The pivoting process was implemented by solving the error equation:

$$E = R_{pv} - V_v' + \frac{2}{m_v} X_{pv} + 10 \log \left[\Gamma(1 + \frac{2}{m_v})\right] \approx 0 \qquad (3\text{-}28)$$

(c.f. equation 3-14) for m_v by Regula Falsi techniques. As may be seen from the nomogram in figure 3-2, such an m_v may be impossible to find for certain values of (R_{pv} - V_v') and X_{pv}. In such cases, the m_v selected was that which gave the smallest error.

An example of the pivoting process is given in figure 3-4. Results of the pivoting process are given in section 3.4, on the line labeled "adjusted." On that line, entries in the column labeled "VTRMS" are predicted values of V_{rms}, based on the computed V_v and V_a component values. An R next to a value of m_a flags cases where the ambient line was pivoted to a Rayleigh slope, and a + *or* - *sign* next to an adjusted V_{rms} value flags cases where predicted and

measured results differed by more than 3 dB. Two plus signs flag cases where the error was more than 6 dB.

Plots of the data are given in section 3.5 for those cases where predicted and measured V_{rms} differed by more than 3 dB.

3.1.4 Multiple-Vehicle APD Prediction

3.1.4.1 Theoretical Considerations

When a receiver has noise from two or more vehicles, it is reasonable to assume that the mean-squared IF signal of the combination is the sum of the mean-squared components of the individual vehicles. This implies additivity of the mean-squared envelope components:

$$V_{v1,n} = 10 \log \left[\sum_{i=1}^{n} 10^{V_{vi}/10} \right] \tag{3-29}$$

where

V_{vi} = vehicular component for vehicle i in dB(μV)

$V_{v1,n}$ = vehicular component for the combination of n vehicles in dB(μV)

If we are interested in the amplitude distribution function for the combination of vehicles, the problem becomes very difficult because of the nonlinearity of the detector. Three different methods were tried to develop the distribution of the sum of vehicular components. The first was to approximate the envelop detector response as taking the sum of the individual component envelopes. This yields the convolution integral, which for two vehicles gives:

$$p_s(z) = \int_z^{\infty} p_1 (r)\, p_2 (z - r)\, dr \tag{3-30}$$

where

$p_1(r_1)$ = density function of the envelope for vehicle 1

$p_2(r_2)$ = density function of the envelope for vehicle 2

$p_s(z)$ = density function of $z = r_1 + r_2$

Due to the high dynamic range of the Weibull variates, this is a difficult convolution to perform on a digital computer, requiring very small intervals and very many calculations for even the two-variate case. And the accuracy is not good, because the mean-square of z will not be equal to the sum of the mean squares of r_1 and r_2.*

A second approach was to model the detector as simply taking the largest of independent Weibull variates:

$$z = \max \left\{ r_1, r_2 \cdots r_n \right\}$$

This yields an easily computed form for the exceedance probability of z (ref 8):

$$P_z(z) = 1 - \prod_{i-1}^{n} \left[1 - P_i(z) \right] \qquad (3\text{-}31)$$

Due to the low duty cycle of vehicular noise, it is unlikely that noise pulses will significantly overlap unless several approximately equally noisy vehicle signals are present simultaneously. This is highly unlikely to occur, so equation 3-31 would seem to be a reasonable approximation for many applications. It is very difficult, however, to determine the mean-squared value of z from equation 3-31, to see how much error accrues from the approximation.

Examination of APD plots for multiple-vehicle tests (see app 5, test codes 16-24) showed that the vehicular component region is essentially Weibull, i.e., a straight line on the graphs, as was the case for single vehicles. This suggested the following model: the detector is considered as taking the largest of Weibull variates at a very low probability level of $P \approx 0.0001$, with the Weibull distribution of the composite envelope having m and K parameters that pass through that point on the APD plot and also give an rms level as required in equation 3-29. The procedure used was to keep track of which vehicle gave the highest threshold level at $P = 0.0001$, then finding the probabilities at that level for all the other vehicles, to come up with the overall exceedance probability for that level (P_z) by equation 3-31. Values of m and K were then

*The instantaneous values in the IF are additive, but not the envelopes, since phase is important. A precise calculation of the composite distribution, given component amplitude and phase distribution, could have been made using Monte Carlo techniques. Such effort did not seem justified for this study.

found to give the desired $V_{v1,n}$ (equation 3-29) by the same Regula Falsi technique as was used in line pivoting with P_z being the pivot point (see equation 3-28.)

Different antennas were used for single-vehicle tests than for multiple-vehicle tests for all frequencies except 23 MHz. This meant that an additive (in dB) correction factor, Δ, had to be applied to the single-vehicle data, to make their envelope statistics commensurate with those for the multiple vehicles (section 3.2.2, below). The m_v parameters were assumed to be unchanged by the gain adjustment, and K_v values were shifted by $m_v\Delta/2$ to yield the desired vehicular rms component (equation 3-13). The extent of error introduced by this procedure could not be determined.

3.1.4.2 Results of Multiple-Vehicle Predictions

Section 3.6 presents the results of the multiple-vehicle APD predictions. In terms of notations used in this text, the tabular headings of the table are: V_v, m_v, K_v, $R_{.0001}$, R_I, and P_I. The table gives values based on the multiple-vehicle measurements, predicted values of the parameters, and the results obtained from the prior single-vehicle measurements for those vehicles involved. Because the ambient line for the multiple-vehicle tests is independent of the vehicles, the "predicted" ambient values are those given in section 3.4 for the multiple-vehicle test codes (16 through 24). A + or ++ beside a line for measured data indicates that the "measured" (actually, deduced from the pivoted vehicular line) V_v in the multiple-vehicle test was greater than V_v for any contributing vehicle by 5 or 10 dB or more, respectively, a possibly erroneous condition. Similarly, - or -- is used to flag occurrences where the multiple-vehicle V_v was less by 5 or 10 dB or more than the largest V_v value for a contributing vehicle. Similar flags next to the predicted V_v value flag 5- and 10-dB error of prediction cases.

Errors in prediction can stem from a variety of causes:

(1) Inaccuracy of the model.

(2) Errors in compensating for antenna gain differences between the single-vehicle and multiple-vehicle tests.

(3) Errors in estimating m_v and K_v.

(4) Errors in assuming that vehicles emitted noise with the same statistics at the time of the single-vehicle test and at the time of the multiple-vehicle test.

(5) Near field and reradiation effects when more than one vehicle is placed in proximity to the receiving antenna.

The reader's attention is called to entries in the table of section 3.6 for test code 18, frequency = 23 MHz, and test codes 19 and 20, frequencies = 23 and 75 MHz. In almost every case, the measured V_v was below the largest

V_v for a contributing vehicle by better than 10 dB, and in some cases by better than 20 dB. An examination of the raw data plots for these cases (app 4) reveals that in each case the measured ambient region of the curve was virtually identical to the plot for receiver noise only, a situation that is nowhere else observed in the data for tests conducted at those frequencies. It is concluded, therefore, that for some reason, signals from the biconical antenna used for those frequencies were greatly attenuated before they reached the NATE receiver input. Whatever the cause, the multiple-vehicle data for those test codes and frequencies are considered to be invalid, and should not be used in assessing the relative merit of the model.

Plots of several of the multiple-vehicle measured and predicted APD are given in section 3.7. Other examples may be found in the main body of the report. The figures show both vehicular and ambient lines for the multiple-vehicle test and vehicular lines for the contributing vehicles. Squares mark the predicted vehicular line. Which line goes with which vehicle is indicated in section 3.6. A + sign on a component line shows where the vehicular and ambient lines intersected at the time of the single-vehicle test. In the list of test codes at the top of the figure, the first value is the test code for the multiple-vehicle test and the remaining values indicate which vehicles (numbered 1 through 12) were involved in the test. The line labeled VRMS marks the measured value of V_{rms} for the test. Frequency and bandwidth codes are defined in the introduction to section 3.7.

A summary of error flag occurrences is given in table 3-I for each frequency and for all frequencies combined. In 66 out of 105 cases, predicted V_{rms} values were within 5 dB of the measured values. In 92 cases, the error was less than 10 dB. There were three cases in which the predicted values were too low by more than 10 dB. Two of those cases were for the two-vehicle case of test code 24 at a frequency of 75 MHz. In the other case, there were no data available on two of the three vehicles in the test. There were 10 cases in which predicted values were too high by more than 10 dB. These errors occurred most frequently at f = 900 MHz and b = 300 kHz. The "measured" V_v was less than the V_v for one of the contributing vehicles by more than 10 dB in 7 out of the 10 cases, and from 5 to 10 dB in the other three cases.

None of the three multiple-vehicle prediction techniques is very satisfactory in predicting the multiple-vehicle APD line. In many cases, equally good or, sometimes, better results would have been achieved by simply picking the vehicle with the largest V_v value (call it V_{vm}) and shifting its APD plot by $(V_{v1,n} - V_{vm})$.

3.1.5 Comparison of m_a with Middleton's Rayleigh Slope

David Middleton has done extensive theoretical work on amplitude probability distribution functions of the IF envelope of a receiver (ref 9 and 10). His model is geared toward the "real world" case of various and sundry dispersed noise emitters and their effect on the receiver. This is somewhat different from the case studied here, where vehicular noise was studied over a time frame in which the vehicles were stationary, quite close to the receiver,

TABLE 3-I. GROSS ERROR SUMMARY OF OCCURRENCES

		Measured					
		--	-	SP	+	++	Total
FREQUENCY 1							
Predicted	--	0	0	0	0	0	0
	-	0	0	0	0	0	0
	SP	0	0	8	0	0	8
	+	0	6	2	0	0	8
	++	0	1	0	0	0	1
Total		0	7	10	0	0	17
FREQUENCY 2							
Predicted	--	0	0	0	0	2	2
	-	0	0	0	3	2	5
	SP	0	0	18	5	0	23
	+	0	1	2	0	0	3
	++	1	0	0	0	0	1
Total		1	1	20	8	4	34
FREQUENCY 3							
Predicted	--	0	0	0	0	1	1
	-	0	0	0	3	0	3
	SP	0	0	22	3	0	25
	+	0	1	4	0	0	5
	++	0	2	0	0	0	2
Total		0	3	26	6	1	36
FREQUENCY 4							
Predicted	--	0	0	0	0	0	0
	-	0	0	0	0	0	0
	SP	0	0	10	0	0	10
	+	0	2	0	0	0	2
	++	6	0	0	0	0	6
Total		6	2	10	0	0	18
TOTAL OF ALL FREQUENCIES							
Predicted	--	0	0	0	0	3	3
	-	0	0	0	6	2	8
	SP	0	0	58	8	0	66
	+	0	10	8	0	0	18
	++	7	3	0	0	0	10
Total		7	13	66	14	5	105

running at constant speed, and provided the dominant source of impulsive noise. Nonetheless, it should be possible to apply Middleton's model to the data of this study. A thorough application of his model to the data will not be attempted, but some pertinent observations will be made in this and the following section.

In his "Class B" model, for impulsive interference such as vehicular noise, the APD function rises up from a base line which has a Rayleigh slope, due to the Gaussian nature of receiver noise and other Gaussian components. As mentioned previously, the Rayleigh distribution is a Weibull distribution for which $m = 2$. In many cases the $m_a = 2$ base line slope was observed, as can be seen by a quick scan down the m_a column in the table of section 3.4. In fact, significant departures from $m = 2$ were seldom observed at frequency codes 3 and 4 (300 and 900 MHz). This was to be expected, since there is very little ambient interference at those high frequencies.

At 75 MHz, however, m_a was nearly 2.0 in only a few instances, if one excludes test codes 19 and 20 from consideration. As discussed in 3.1.4.2, above, these tests are highly suspect on other grounds, as well. At 23 MHz only two cases of $m_a \approx 2$ were noted, except for test codes 18 through 20. Part of the reason for this is that the APD plots in this study only extend up to $P = 0.4$, and the lower frequencies generally had significant ambient interference (other than receiver noise). There seems little doubt that the Rayleigh base line would have been observed in most if not all cases, if thresholds at high probabilities had been measured.

In most cases, both at 75 and 23 MHz, m_a was significantly larger than 2.0, indicating the presence of essentially CW interference components in the ambient signals. This is also indicated by observed values of V_d less than 1.05 dB. In Middleton's terminology, this places our data in the "Class C" classification--a combination of impulsive (Class B) and narrowband (Class A) interference. His transition threshold for the Class A component must have occurred at probabilities greater than 0.4, since no cases of roll-off of the ambient lines were observed. No cases (except for test code 20) were observed at 23 MHz in which the ambient line had $m_a < 2$. In a few cases (see app 4), the APD plot of the ambient condition showed a change in slope at very low probabilites; but apparently at 23 MHz, the ambient is dominated by low-level, essentially CW interferers.

3.1.6 Comparison of $m_?$ and Point of Intersection with Middleton's α and Γ'_B

In Middleton's Class B model, the APD curve in the impulsive noise-dominated region is described by a series of hypergeometric functions (ref 9, equation 2-17) that lift the curve away from the Rayleigh base line, starting at a point $(R - V_{rms}) \approx \Gamma'_B$(dB), with the curve rising with increasingly greater slope (in magnitude) as probability decreases, until a critical "bend-over" point is reached, at a probability $\approx A_B$ (see ref 9, fig. 1). The curve is described by a set of six parameters:

$$P_{6B} \equiv \left\{ A_B, \quad \Gamma'_B, \quad \Omega_{2B}, \quad \alpha, \; b_{1\alpha}, \; N_I \right\} \tag{3-32}$$

where:

A_B and Γ'_B were described above

Ω_{2B} = mean-squared impulsive noise component at IF

$b_{1\alpha}$ = weighted moment of the generic envelope B_{0B}

N_I = scaling parameter

α = spatial density-propagation law parameter

The parameter α is a composite parameter that considers both the spatial distribution of the various interference sources and the propagation law (i.e., slope of path loss versus 10 times the log of distance). This writer cannot assign a meaningful value to α for the cases examined in this study, where a single set of fixed-location vehicles provided the impulsive interference. However, Middleton states (ref 9, p. 200) that "some measure of the slope" of the curve "often gives a surprisingly accurate estimate, within the order of 10 percent," and he gives the equation (slightly rewritten for greater clarity and in the notation of this report):

$$\alpha \approx \log \left[\text{Prob } (R \geq V_{rms}) \right] \quad - \quad \log \left[\text{Prob } (R \geq RB) \right] \tag{3-33}$$

where:

R_B is the envelope threshold level at the bend-over point.

In quite a few cases, the data of this study do show a bend-over tendency at very low probabilities, but it would be difficult to assign actual values to R_B and A_B. In most cases in this study, envelope thresholds at a value of V_{rms} were down in the ambient regions. This may be seen by skimming through the tables in section 3.4 and noting how seldom V_{rms} (column labeled VTRMS) is greater than the dB level at the intersection of the vehicular and ambient lines. Thus, α estimates made by equation 3-33 would not necessarily be descriptive of the slope ($-2/m_v$ for a Weibull fit) of the curve in the vehicular region.

Middleton's defining equation for Γ'_B is:

$$\Gamma'_B = \sigma_G^2/\Omega_{2B} \qquad (3\text{-}34)$$

where:

σ_G^2 = mean-squared Gaussian component in the IF

Ω_{2B} = mean-squared "impulsive" component in the IF

Since the IF and envelope component values are proportional, the equation for Γ'_B becomes, in the notation of this report,

$$\Gamma'_B = V_a - V_v \qquad \text{(dB)}$$

$$\Gamma'_B = 10^{(V_a - V_v)/10} \qquad \text{(as a ratio)} \qquad (3\text{-}35)$$

when the ambient slope parameter, m_a, is 2.

He states, "Γ'_B is quite closely determined when the envelope threshold... is normalized vis-a-vis [the mean-squared value]...corresponding to the point where the [curve] begins to depart from the Rayleigh" (ref 9, p. 200). If we call this departure level R_d [dB(μv)], then

$$\Gamma'_B \approx R_d - V_{rms} \qquad \text{(dB)}$$

$$\approx 10^{(R_d - V_{rms})/10} \qquad \text{(as a ratio)} \qquad (3\text{-}36)$$

It is tempting to equate R_d with R_I, the level at the intersection of the vehicular and ambient component lines. However, the interested reader can verify for himself from data in the table in section 3.4 that, in general

$$(R_I - V_{rms}) \neq (V_a - V_v)$$

and frequently the difference is quite large. (In the table in section 3.4, V_{rms} is listed under VTRMS, R_I is listed under "INTERSECT: DB," V_a is under "VARMS," and V_v is under "VVRMS.") Thus, one should not attempt to equate Middleton's "departure from the Rayleigh" point with R_I of this study. His Γ'_B can be estimated, however, by equation 3-35.

Note that Middleton's observations were based on situations where the bulk of the noise energy was from impulsive sources, rather than ambient or receiver noise. This was not the case here, where the ambient contributed a significant portion of the total energy.

3.1.7 Investigation of Gaussian Components in Vehicular Noise

Several investigators have reported finding a Gaussian component (in addition to receiver noise) in man-made and atmospheric noise studies (ref 6). Middleton's model for Class B noise predicts a Gaussian component due to the impulsive interference given by

$$\Omega_{2B}^{(G)} = \left(\frac{4-\infty}{2-\infty}\right)\Omega_{2B}$$

(ref 11, equation 2.88c; c.f. ref 9 equations 2.15a, 2.12a).

In the tests of this study, no such Gaussian components attributable to the test vehicles were observed in any of the single-vehicle tests. With 12 vehicles (test code 16) and in one of the 6-vehicle tests (test code 18), some indication of a Gaussian component was observed for some test conditions, particularly at 75 MHz.

Figures 3-5 through 3-12 are raw data plots for the two noisiest vehicles when the ambient line was essentially Rayleigh and when a significant amount of impulsive noise was present. Included on the figures are estimated V_v and V_a values from straight line Weibull fits to the data (prior to pivoting). As is apparent in the figures, there are no significant differences between the levels at higher probabilities for receiver system noise, the ambient, or with the vehicles on.

Figures 3-13 through 3-21 show results from the 12-vehicle test when the ambient line was essentially Rayleigh. Again, estimates of V_v and V_a from line fitting are given, along with the measured value of the rms for the ambient condition (V_{amb}). Also included is an estimate of the Gaussian component in the IF due to the vehicles. This is called $\Omega_{2B}^{(G)}$ to conform to Middleton's notation, and is computed as:

$$\Omega_{2B}^{(G)} \doteq \frac{1}{2}\left[10^{\hat{V}_a/10} - 10^{V_{amb}/10}\right] \quad [(\mu V)^2]$$

expressed in dB(μV):

$$\Omega_{2B}^{(G)} \doteq 10 \log\left[\frac{1}{2}\left(10^{\hat{V}_a/10} - 10^{V_{amb}/10}\right)\right] \quad [\mathrm{dB}(\mu V)$$

No attempt was made to estimate $\Omega_{2B}^{(G)}$ when the difference between $\hat{V}_a$ and V_{amb} was less than 1 dB.

As can be seen in the figures, the Gaussian component due to vehicular noise contributed at most a 3.3-dB shift to the ambient line, and reasonably good estimates of $\Omega_{2B}^{(G)}$ could only be made at 75 MHz. In all other cases, ambient or system noise components obscured any Gaussian components from the vehicles.

(Text continued on page 3-40)

VEHICLE NOISE TEST
13

08/16/79 (M/D/Y)
23:27:05 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION
DODGE PU Blue V8??PICK UP

ANTENNA DESCRIPTION
LOG APN-107

TEST CODE: 1 VEHICLES IN THE TEST: 1

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	800E-02	31.2
2	.0005	580E-01	27.2
3	.0010	600E-01	26.2
4	.0100	476E+00	-3.5
5	.0200	224E+01	-5.5
6	.0500	396E+01	-6.5
7	.1000	659E+01	-7.5
8	.2000	115E+02	-9.4
9	.3000	132E+02	-10.4
10	.4000	142E+02	-11.4

Cal. RMS	Vavg	Vd	Vp	Noise P.
53.6dBuV	23.2dBuV	9.9dB	63.4dBuV	-76.9dBm

$\hat{V}_v = 39.9$ dB(µV) $\hat{V}_a = 21.9$ dB(µV)

RMS level compares to 14.51 dB above kTo = 33.11 dBuV across 50ohms

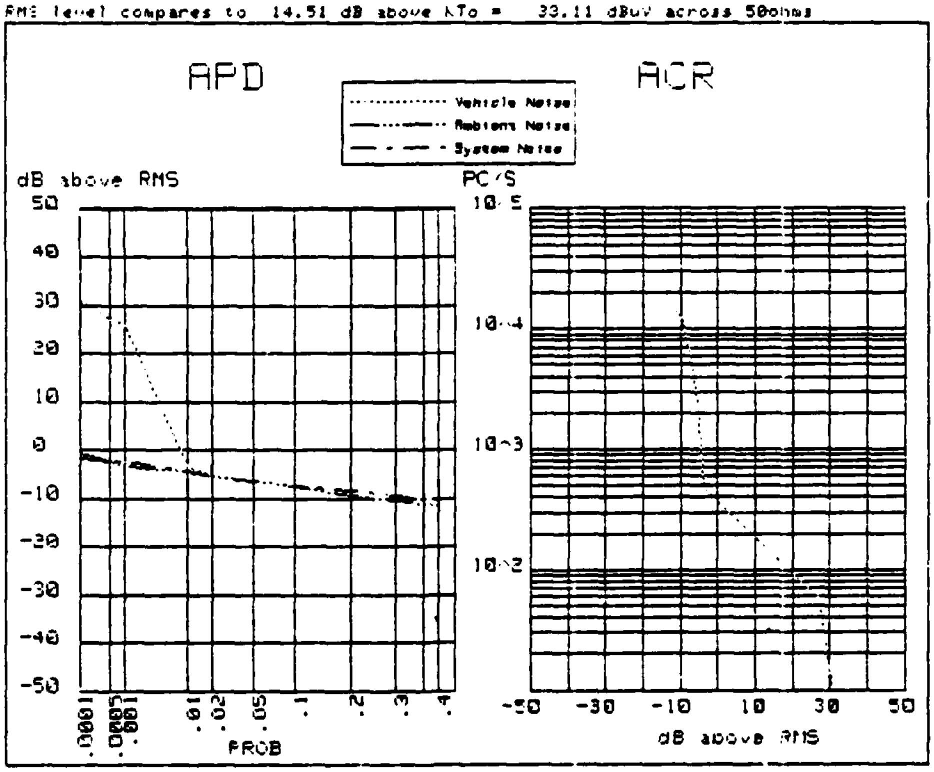


Figure 3-5. APD/ACR data plots for test 13 and test code 1 with Rayleigh ambient.

VEHICLE NOISE TEST 14 — 08/16/79 (M/D Y) 23:32:25 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION	ANTENNA DESCRIPTION
DODGE PU Blue V8??PICK UP	LOG APN-107

TEST CODE: 1 VEHICLES IN THE TEST: 1

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	100 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	220E-01	34.1
2	.0005	830E-01	26.2
3	.0010	108E+00	16.3
4	.0100	495E+01	-5.5
5	.0200	476E+01	-5.5
6	.0500	179E+02	-7.5
7	.1000	275E+02	-8.5
8	.2000	367E+02	-9.5
9	.3000	455E+02	-10.5
10	.4000	509E+02	-11.5

Cal. RMS	Vavg	Vd	Vp	Noise P.
58.3dBuV	27.3dBuV	10.9dB	74.3dBuV	-71.9dBm

$\hat{V}_v = 46.6$ dB(μV) $\hat{V}_a = 26.6$ dB(μV)

RMS level compares to 14.80 dB above kTo = 38.09 dBuV across 50ohms

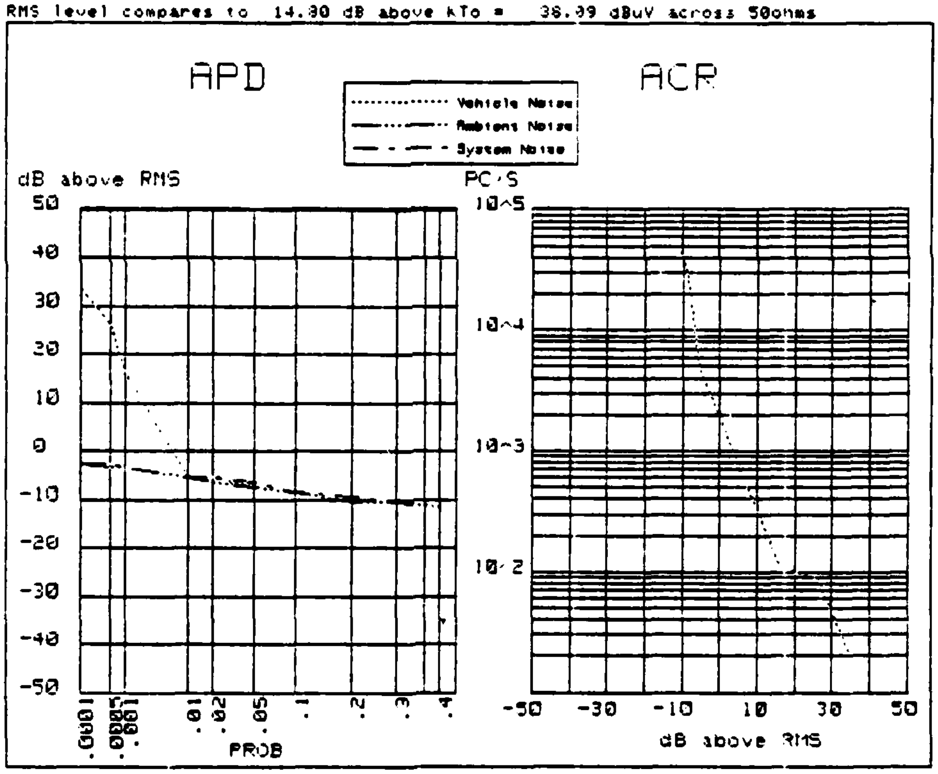


Figure 3-6. APD/ACR data plots for test 14 and test code 1 with Rayleigh ambient.

TEST SETUP DATA:

VEHICLE NOISE TEST
15

08/16/79 (M/D/Y)
23:37:30 (H:M:S)

VEHICLE DESCRIPTION
DODGE PU Blue V8977PICK UP

ANTENNA DESCRIPTION
LOG APN-107

TEST CODE: 1 VEHICLES IN THE TEST: 1

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	700E-01	32.9
2	.0005	150E+00	18.0
3	.0010	260E+00	10.1
4	.0100	907E+01	-6.7
5	.0200	215E+02	-7.7
6	.0500	413E+02	-8.7
7	.1000	666E+02	-9.7
8	.2000	118E+03	-11.7
9	.3000	136E+03	-12.7
10	.4000	146E+03	-13.7

Cal. RMS	Vavg	Vd	Vo	Noise F.
63.0dBuV	31.5dBuV	12.8dB	32.0dBuV	-65.7dBm

$\hat{V}_v = 62.2$ dB(μV) $\hat{V}_a = 30.8$ dB(μV)

RMS level compares to 16.32 dB above kTo = 44.27 dBuV across 50ohms

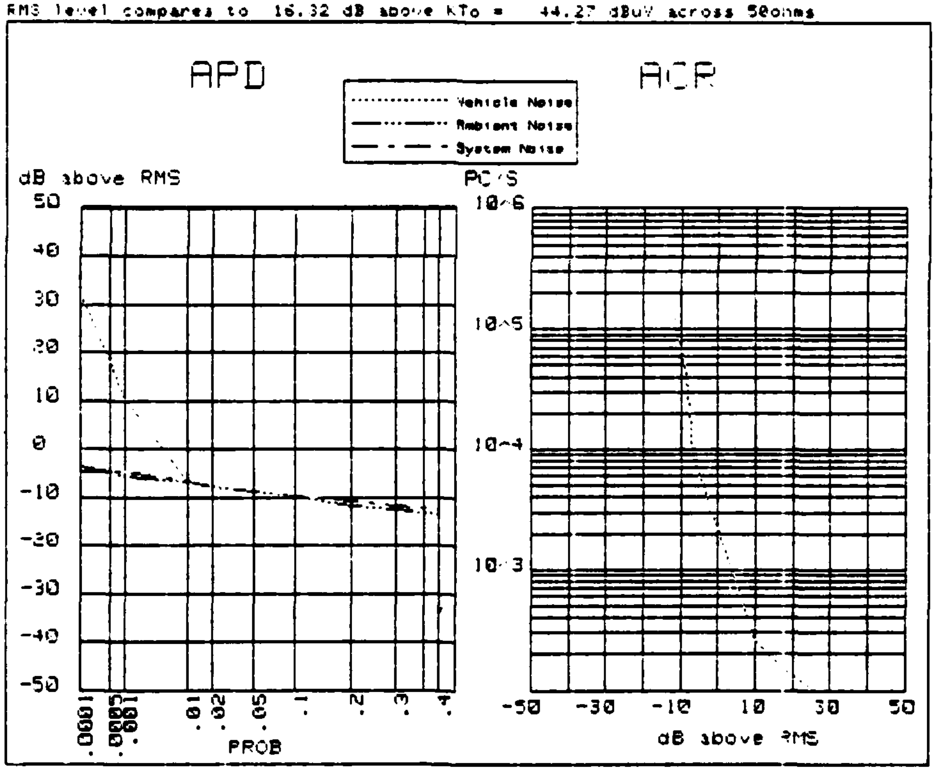


Figure 3-7. APD/ACR data plots for test 15 and test code 1 with Rayleigh ambient.

VEHICLE NOISE TEST 16 — 08 16/79 (M/D/Y) 23:43:23 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION	ANTENNA DESCRIPTION
DODGE PU Blue V89??PICK UP	LOG APN-107

TEST CODE: 1   VEHICLES IN THE TEST: 1

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	100 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	280E-01	32.8
2	.0005	680E-01	21.0
3	.0010	960E-01	13.0
4	.0100	535E+01	2.1
5	.0200	529E+01	2.1
6	.0500	196E+02	.2
7	.1000	295E+02	-.8
8	.2000	389E+02	-1.8
9	.3000	467E+02	-2.8
10	.4000	523E+02	-3.8

Cal. RMS	Vavg	Vd	Vp	Noise P.
51.2dBuV	19.5dBuV	4.0dB	52.3dBuV	-86.5dBm

$\hat{V}_v$ = 34.6 dB(µV) $\hat{V}_a$ = 19.7 dB(µV)

RMS level compares to 7.32 dB above kTo = 23.50 dBuV across 50ohms

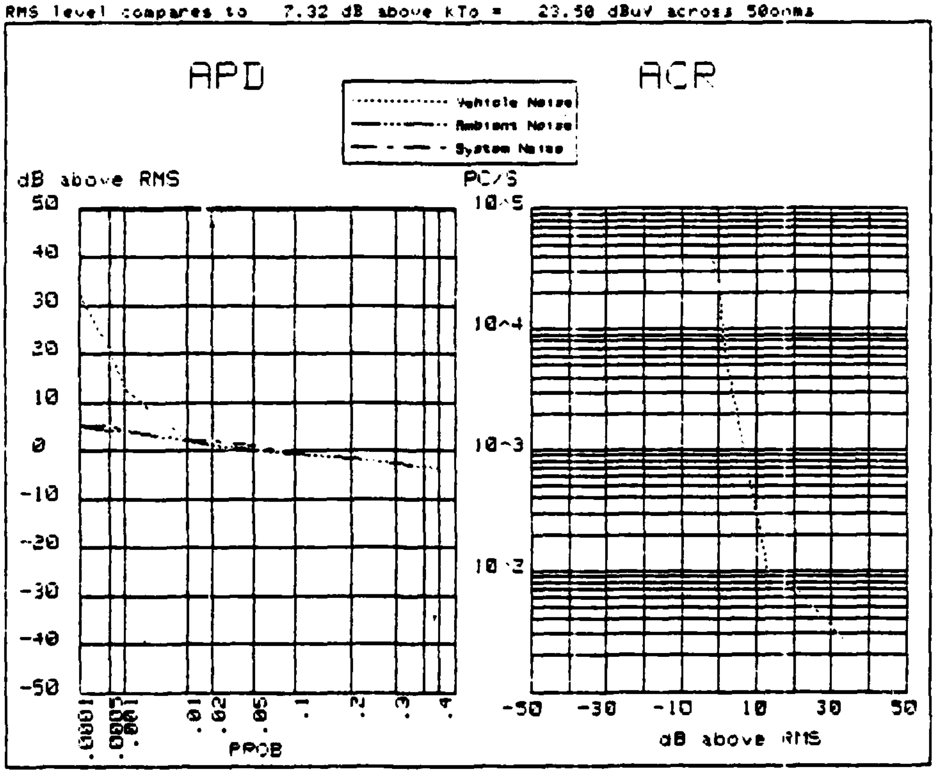


Figure 3-8. APD/ACR data plots for test 16 and test code 1 with Rayleigh ambient.

TEST SETUP DATA:	VEHICLE NOISE TEST 6	08/18/79 (M/D/Y) 07:37:15 (H:M:S)

VEHICLE DESCRIPTION
FORD PINTO 4 CYL

ANTENNA DESCRIPTION
LOG PERIODIC VERT

TEST CODE: 9   VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	100E-02	29.8
2	.0005	100E-01	25.8
3	.0010	230E-01	23.9
4	.0100	120E+00	4.1
5	.0200	454E+00	-2.9
6	.0500	129E+01	-4.3
7	.1000	197E+01	-5.9
8	.2000	362E+61	-7.3
9	.3000	423E+01	-8.8
10	.4000	476E+01	-9.8

Cal. RMS	Vavg	Vd	Vp	Noise P.
48.0dBuV	18.1dBuV	8.5dB	47.2dBuV	-83.5dBm

$\hat{V}_v$ = 27.9 dB(μV) $\hat{V}_a$ = 17.0 dB(μV)

RMS level compares to 13.55 dB above KTo = 26.53 dBuV across 50ohms

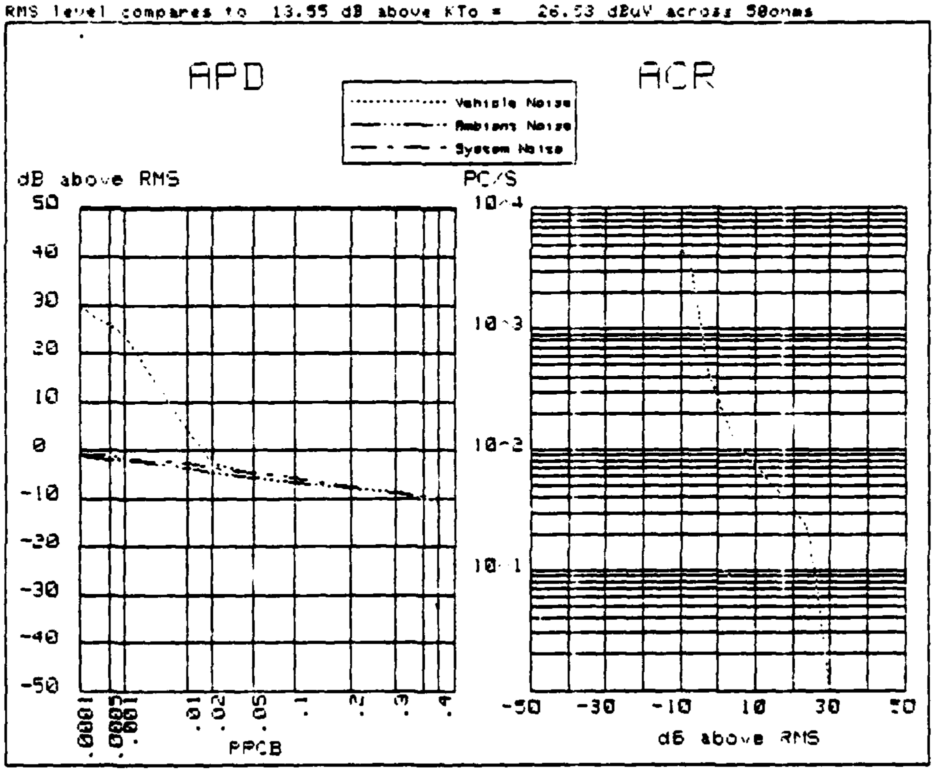


Figure 3-9. APD/ACR data plots for test 6 and test code 9 with Rayleigh ambient.

TEST SETUP DATA:	VEHICLE NOISE TEST 7	08/18 79 (M D Y) 07:44:31 (H:M:S)

VEHICLE DESCRIPTION	ANTENNA DESCRIPTION
FORD PINTO 4 CYL	LOG PERIODIC VERT

TEST CODE: 9 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	140E-01	32.2
2	.0005	360E-01	29.2
3	.0010	440E-01	26.2
4	.0100	364E+00	.5
5	.0200	131E+01	-2.5
6	.0500	358E+01	-3.5
7	.1000	593E+01	-4.5
8	.2000	111E+02	-6.4
9	.3000	129E+02	-7.4
10	.4000	143E+02	-8.4

Cal. RMS	Vavg	Vd	Vp	Noise P.
53.5dBuV	22.3dBuV	7.8dB	61.6dBuV	-79.9dBm

$\hat{V}_v$ = 36.3 dB(uV) $\hat{V}_a$ = 21.9 dB(μV)

RMS level compares to 11.66 dB above KTo = 30.11 dBuV across 50ohms

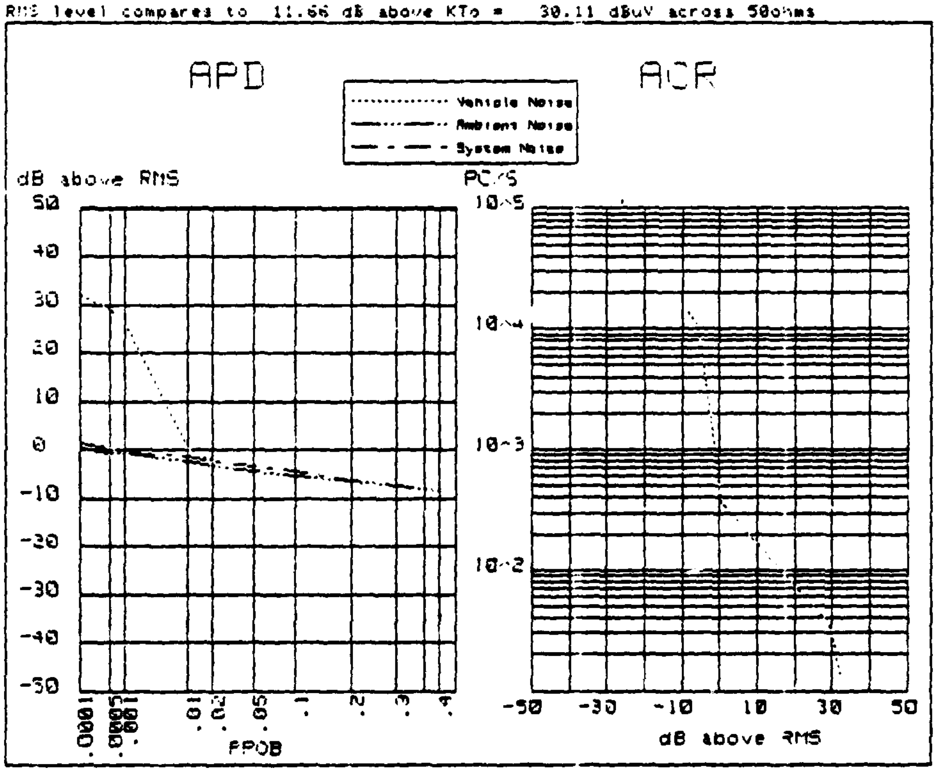


Figure 3-10. APD/ACR data plots for test 7 and test code 9 with Rayleigh ambient.

VEHICLE NOISE TEST 08 18/79 (M/D/Y)

TEST SETUP DATA: 8 07:50:43 (H:M:S)

VEHICLE DESCRIPTION: FORD PINTO 4 CYL

ANTENNA DESCRIPTION: LOG PERIODIC VERT

TEST CODE: 9 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	100 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Va g	Vd	Vp	Noise P.
1	.0001	300E-01	33.7	58.4dBuV	26.8dBuV	9.7dB	73.8dBuV	-73.5dBm
2	.0005	600E-01	20.8					
3	.0010	112E+00	11.9					
4	.0100	225E+01	-3.0					
5	.0200	544E+01	-4.0					
6	.0500	192E+02	-5.9					
7	.1000	286E+02	-6.9					
8	.2000	380E+02	-7.9					
9	.3000	463E+02	-8.9					
10	.4000	512E+02	-9.9					

$\hat{V}_v = 52.6$ dB(μV) $\hat{V}_a = 26.6$ dB(μV)

RMS level compares to 13.17 dB above KTo = 36.55 dBuV across 50ohms

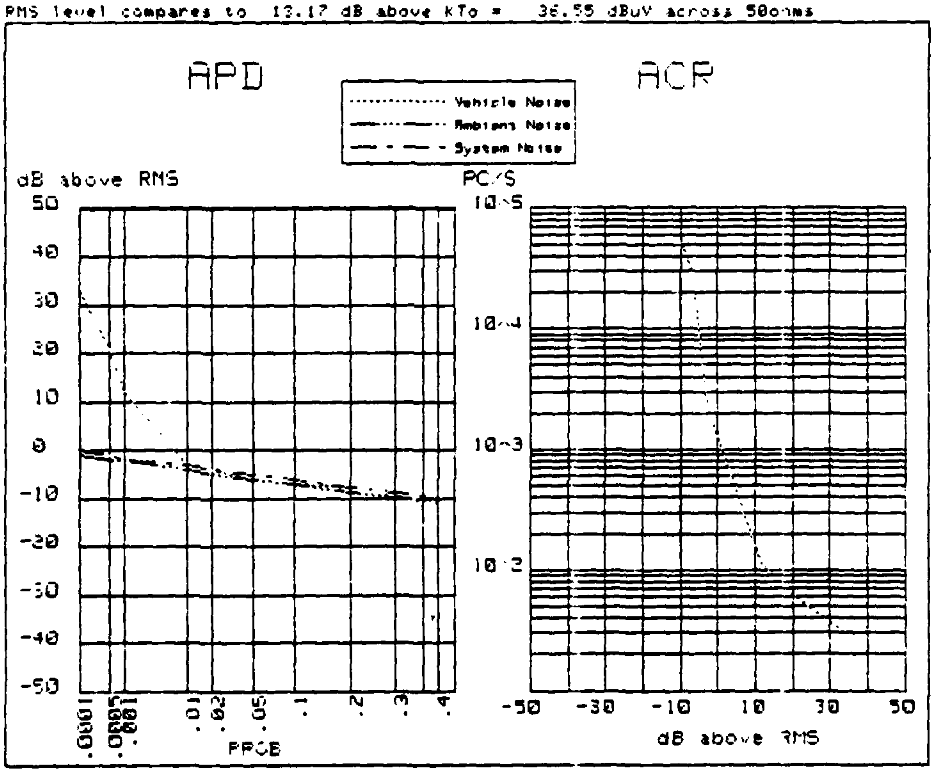


Figure 3-11. APD/ACR data plots for test 8 and test code 9 with Rayleigh ambient.

VEHICLE NOISE TEST
9

08 18 79 (M/D/Y)
07:57:27 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION	ANTENNA DESCRIPTION
FORD PINTO 4 CYL	LOG PERIODIC VERT

TEST CODE: 9 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	560E-01	35.9
2	.0005	176E+00	17.1
3	.0010	338E+00	7.2
4	.0100	124E+02	-1.7
5	.0200	254E+02	-2.7
6	.0500	466E+02	-3.7
7	.1000	727E+02	-4.7
8	.2000	101E+03	-5.7
9	.3000	125E+03	-6.7
10	.4000	140E+03	-7.7

Cal. RMS	Vavg	Vd	Vp	Noise P.
63.2dBuV	31.3dBuV	7.9dB	81.3dBuV	-70.7dBm

$\hat{V}_v$ = 77.2 dB(μV) $\hat{V}_a$ = 31.6 dB(μV)

RMS level compares to 11.00 dB above KTo = 39.25 dBuV across 50ohms

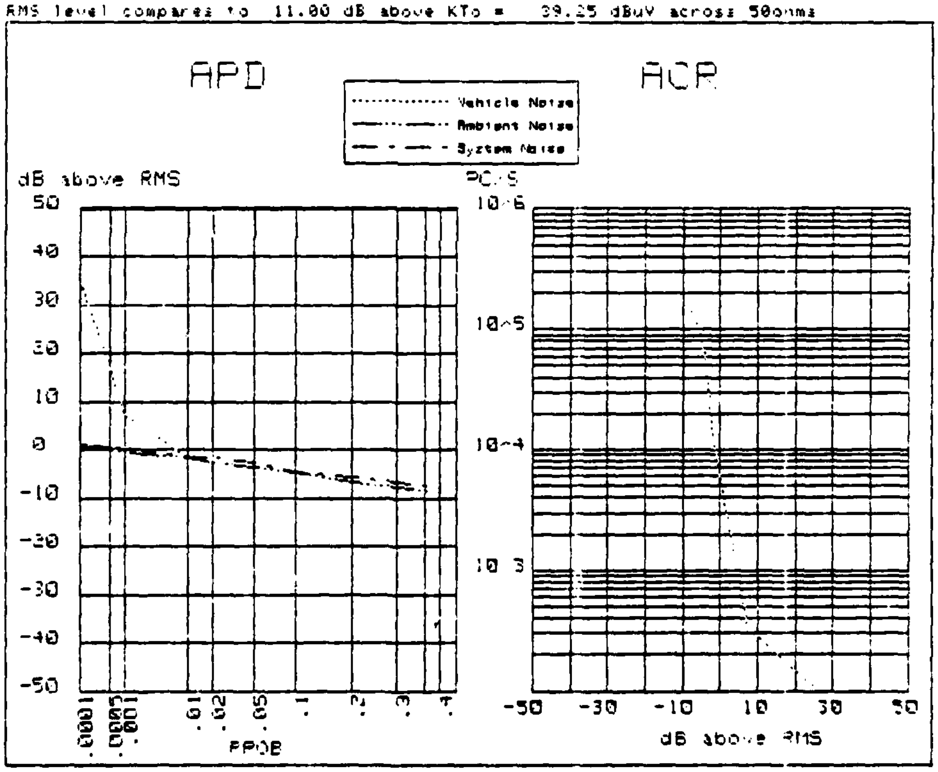
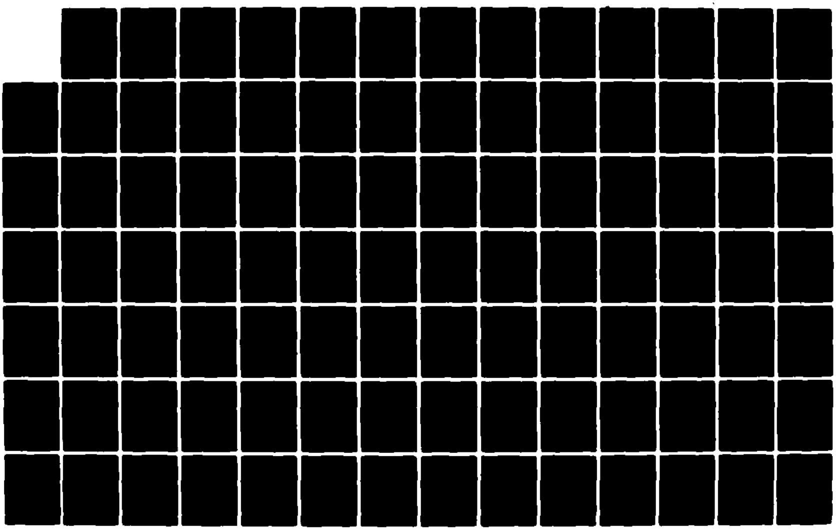
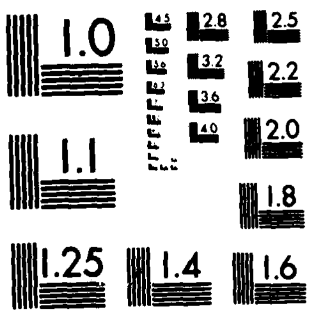


Figure 3-12. APD/ACR data plots for test 9 and test code 9 with Rayleigh ambient.

AD-A121 580 VEHICLE NOISE MEASUREMENTS(U) ARMY ELECTRONIC PROVING GROUND FORT HUACHUCA AZ APR 80 USAEPG-FR-1065-3 2/3

UNCLASSIFIED F/G 20/1 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

VEHICLE NOISE TEST 08/21/79 (M/D/Y)
TEST SETUP DATA: 5 19:25:01 (H:M:S)

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	BICON TYPE 407

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	100E-01	27.3
2	.0005	400E-01	23.3
3	.0010	820E-01	21.3
4	.0100	498E+00	12.4
5	.0200	798E+00	7.5
6	.0500	157E+01	.5
7	.1000	310E+01	-7.4
8	.2000	598E+01	-12.3
9	.3000	906E+01	-14.3
10	.4000	101E+02	-15.3

Cal. RMS	Vavg	Vd	Vp	Noise F.
52.6dBuV	37.7dBuV	9.1dB	72.0dBuV	-63.1dB

$\hat{V}_v$ = 46.3 dB(μV) $\hat{V}_a$ = 32.4 dB(μV)

V_{amb} = 30.0 dB(μV)

$\Omega_{2B}^{(G)} \doteq$ 25.7 dB(μV)

RMS level compares to 29.32 dB above KTo = 46.19 dBuV across 50ohms

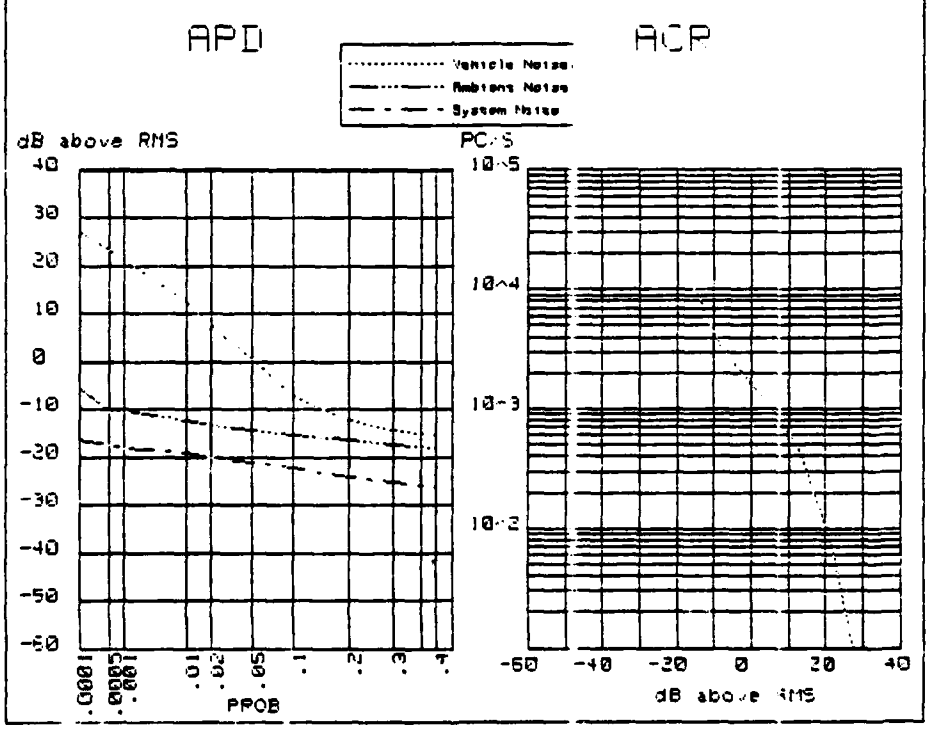


Figure 3-13. APD/ACR data plots for test 5 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST
6

08/21/79 (M/D/Y)
19:31:11 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	BICON TYPE 407

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	100 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	560E-01	29.3
2	.0005	166E+00	25.4
3	.0010	270E+00	23.4
4	.0100	135E+01	10.5
5	.0200	239E+01	3.6
6	.0500	542E+01	-5.3
7	.1000	101E+02	-11.3
8	.2000	279E+02	-15.2
9	.3000	350E+02	-15.2
10	.4000	379E+02	-16.2

Cal. RMS	Vavg	Vd	Vp	Noise P.
57.5dBuV	39.3dBuV	11.5dB	94.1dBuV	-59.2dBm

$\hat{V}_v$ = 51.2 dB(μV)

$\hat{V}_a$ = 34.8 dB(μV)

V_{amb} = 32.5 dB(μV)

$\Omega_{2B}^{(G)} \doteq$ 27.9 dB(μV)

RMS level compares to 28.27 dB above KTo = 50.79 dBuV across 50ohms

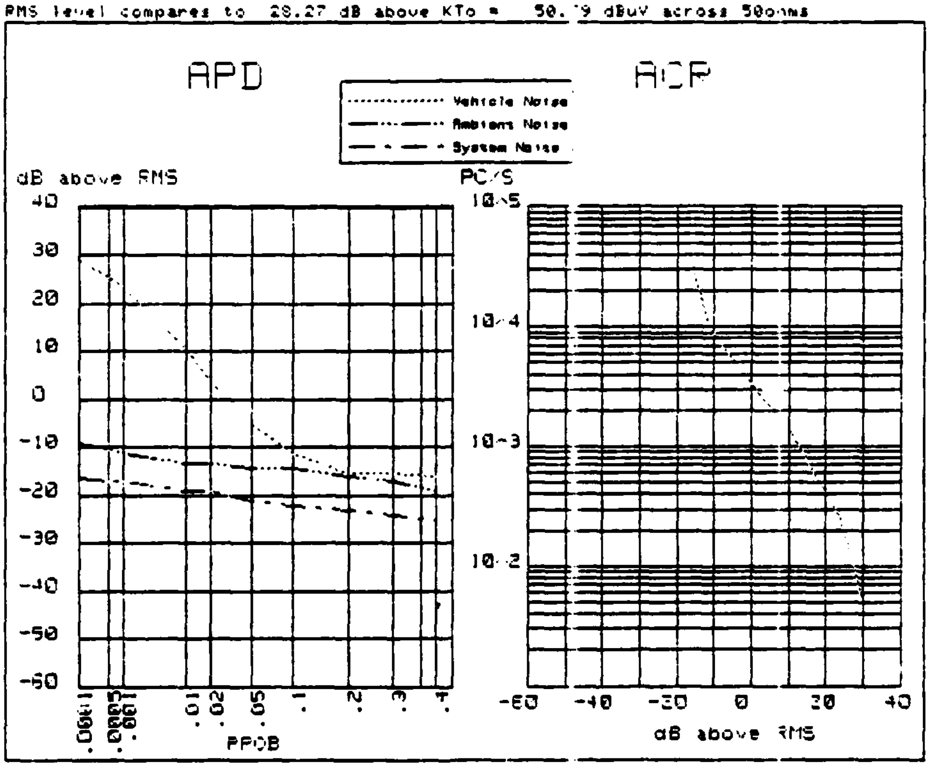


Figure 3-14. APD/ACR data plots for test 6 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST
7

08 21 79 (M D Y)
20:40:54 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON TYPE 407

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	192E+00	33.3
2	.0005	308E+00	24.4
3	.0010	530E+00	21.4
4	.0100	394E+01	6.6
5	.0200	616E+01	2.6
6	.0500	117E+02	-9.3
7	.1000	392E+02	-14.2
8	.2000	703E+02	-16.2
9	.3000	939E+02	-17.2
10	.4000	108E+03	-18.2

Cal. RMS	Vavg	Vd	Vp	Noise F.
61.8dBuV	43.4dBuV	13.3dB	92.3dBuV	-53.2dBm

$\hat{V}_v$ = 57.9 dB(μV)

$\hat{V}_a$ = 38.7 dB(μV)

V_{amb} = 35.4 dB(μV)

$\Omega_{2B}^{(G)} \doteq$ 33.0 dB(μV)

RMS level compares to 29.91 dB above kTo = 56.72 dBuV across 50ohms

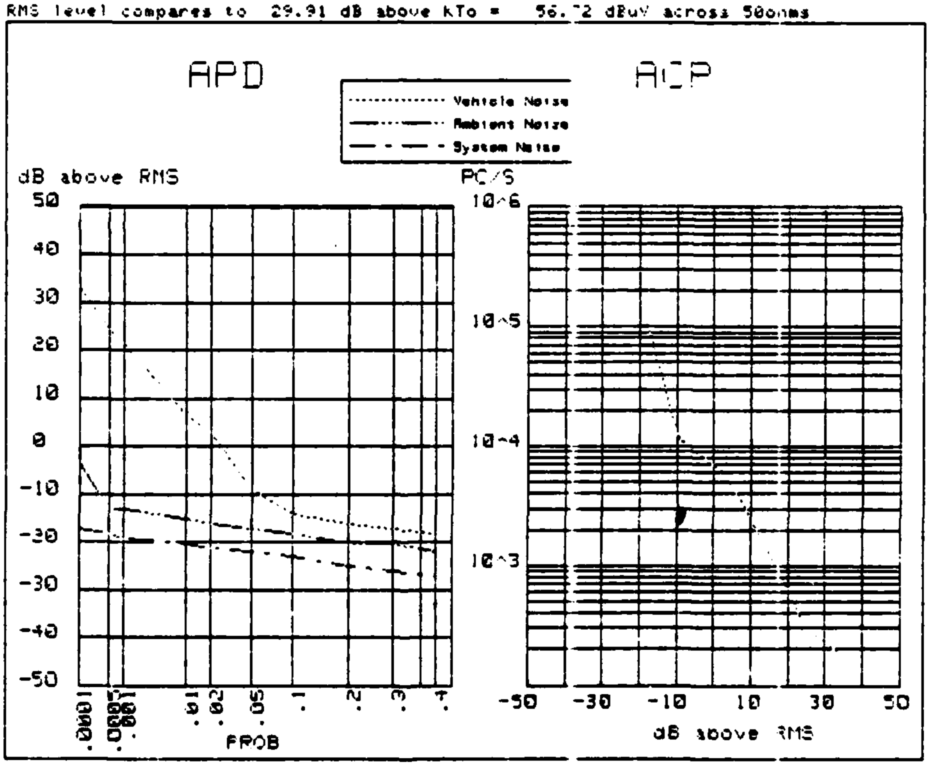


Figure 3-15. APD/ACR data plots for test 7 and test code 16 with Rayleigh ambient.

TEST SETUP DATA:

VEHICLE NOISE TEST 8

08/21/79 (M/D/Y)
20:54:03 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
DIPOLE AC-105 KIT

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	400E-02	28.0
2	.0005	140E-01	24.0
3	.0010	290E-01	21.0
4	.0100	167E+00	13.1
5	.0200	373E+00	8.2
6	.0500	733E+00	2.2
7	.1000	137E+01	-3.7
8	.2000	283E+01	-7.7
9	.3000	335E+01	-8.7
10	.4000	429E+01	-10.6

Cal. RMS	Vavg	Vd	Vp	Noise P.
46.9dBuV	20.8dBuV	6.6dB	48.5dBuV	-62.6dBm

$\hat{V}_v$ = 27.5 dB(μV) $\hat{V}_a$ = 17.8 dB(μV)

V_{amb} = 15.6 dB(μV)

$\Omega_{2B}^{(G)} \doteq$ 10.8 dB(μV)

RMS level compares to 15.50 dB above KTo = 27.59 dBuV across 50ohms

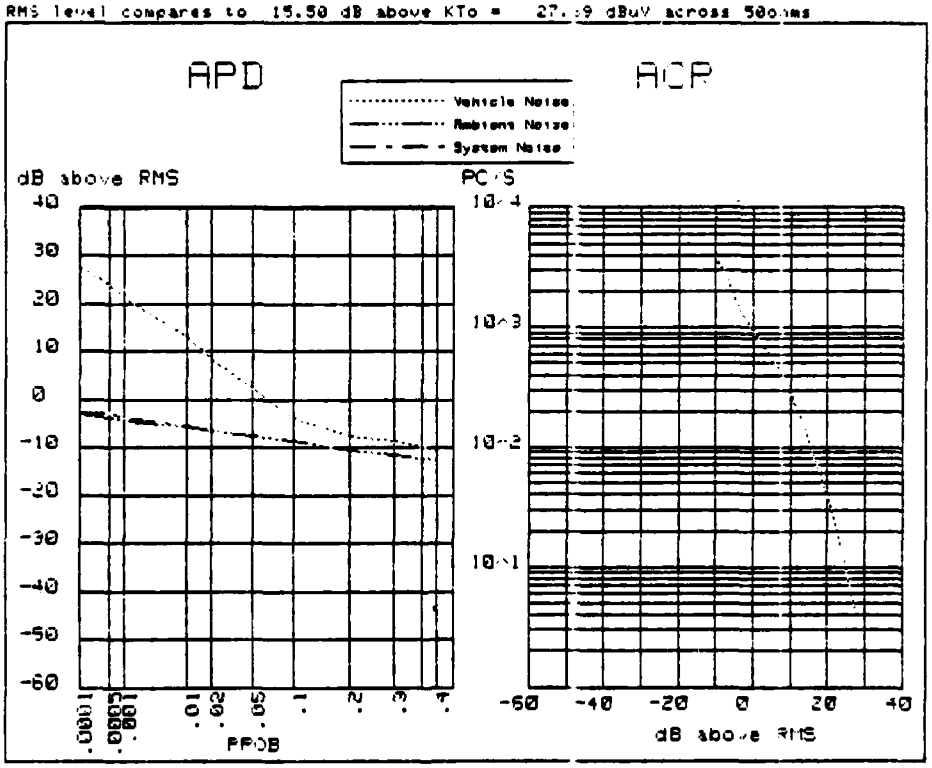


Figure 3-16. APD/ACR data plots for test 8 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST
9

08/21/79 (M/D/Y)
21:00:54 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	DIPOLE AC-105 KIT

TEST CODE: 16   VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	130E-01	29.1
2	.0005	400E-01	25.2
3	.0010	860E-01	22.2
4	.0100	466E+00	12.3
5	.0200	830E+00	7.4
6	.0500	192E+01	-1.6
7	.1000	395E+01	-5.5
8	.2000	906E+01	-8.5
9	.3000	111E+02	-9.5
10	.4000	133E+02	-11.5

Cal. RMS	Va g	Vd	Vp	Noise P.
52.1dBuV	24.5dBuV	7.7dB	57.8dBuV	-77.3dBm

$\hat{V}_v = 32.5$ dB(μV) $\hat{V}_a = 22.3$ dB(μV)

$V_{amb} = 20.4$ dB(μV)

$\Omega_{2B}^{(G)} \doteq 14.8$ dB(μV)

RMS level compares to 15.09 dB above KTo = 32.[illegible]6 dBuV across 50ohms

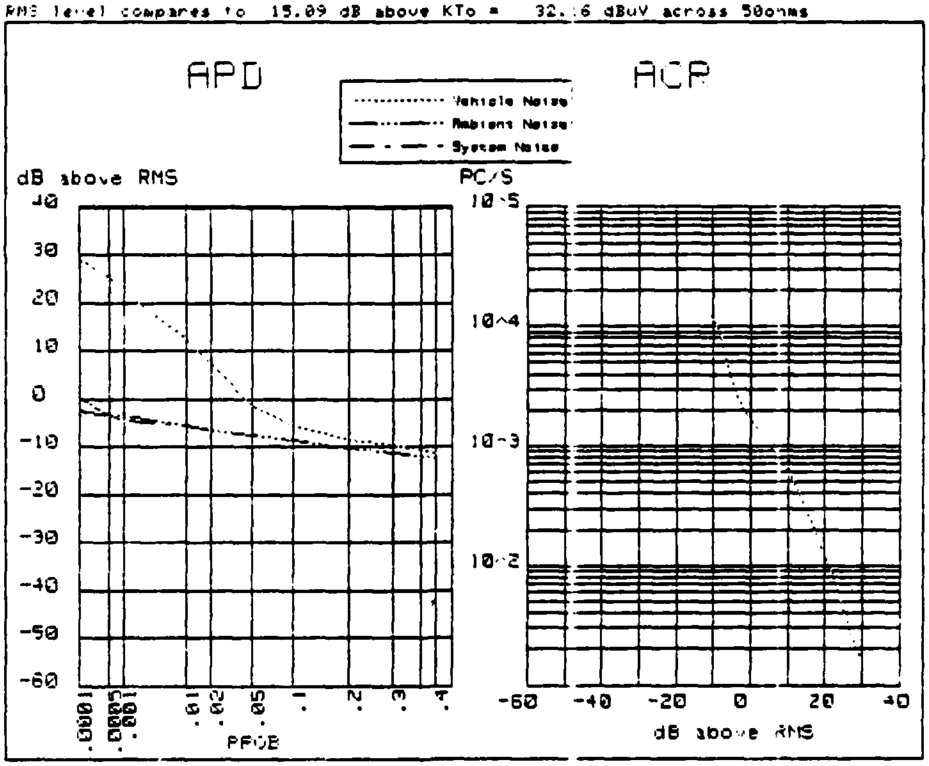


Figure 3-17. APD/ACR data plots for test 9 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST 10 — 08/21/79 (M D/Y) 21:08:41 (H:M:S)

TEST SETUP DATA;

VEHICLE DESCRIPTION: CIVILIAN PASS. (6 OR 8 CYL)

ANTENNA DESCRIPTION: DIPOLE AC-105 KIT

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	100 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	280E-01	31.4
2	.0005	114E+00	25.5
3	.0010	240E+00	21.5
4	.0100	142E+01	6.7
5	.0200	268E+01	1.7
6	.0500	873E+01	-5.2
7	.1000	187E+02	-7.2
8	.2000	345E+02	-9.1
9	.3000	424E+02	-10.1
10	.4000	480E+02	-11.1

Cal. RMS	Vavg	Vd	Vp	Noise P.
56.9dBuV	28.0dBuV	8.8dB	66.1dBuV	-73.2dBm

$\hat{V}_v$ = 37.1 dB(μV) $\hat{V}_a$ = 25.9 dB(μV)

V_{amb} = 25.0 dB(μV)

$\Omega_{2B}^{(G)} \doteq$?

RMS level compares to 14.89 dB above KTo = 36.78 dBuV across 50ohms

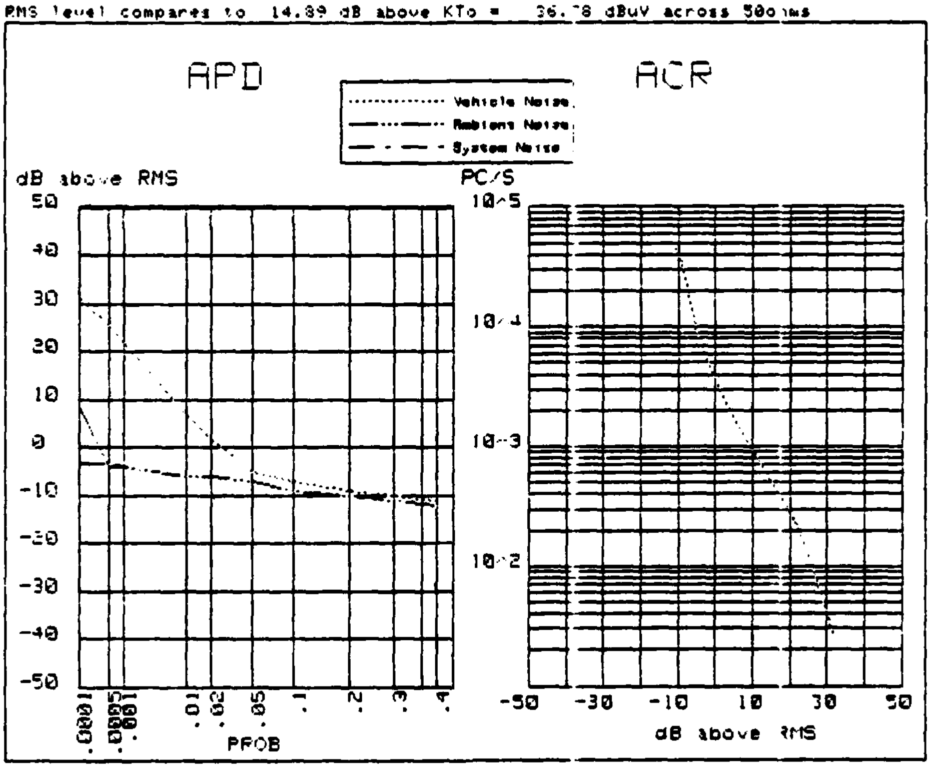


Figure 3-18. APD/ACR data plots for test 10 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST 11

TEST SETUP DATA:

08/21/79 (M/D/Y)
21:45:30 (H:M:S)

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	DIPOLE AC-105 KIT

TEST CODE: 16   VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms
1	.0001	740E-01	34.9
2	.0005	262E+00	28.0
3	.0010	560E+00	23.0
4	.0100	374E+01	7.2
5	.0200	604E+01	2.2
6	.0500	253E+02	-3.7
7	.1000	625E+02	-5.7
8	.2000	107E+03	-7.7
9	.3000	126E+03	-8.7
10	.4000	138E+03	-9.6

Cal. RMS	Vavg	Vd	Vp	Noise F.
61.4dBuV	31.5dBuV	7.6dB	80.3dBuV	-70.7dBm

$\hat{V}_v$ = 42.9 dB(μV) $\hat{V}_a$ = 30.0 dB(μV)

V_{amb} = 29.9 dB(μV)

$\Omega_{2B}^{(G)} \doteq ?$

RMS level compares to 12.89 dB above KTo = 39.06 dBuV across 50ohms

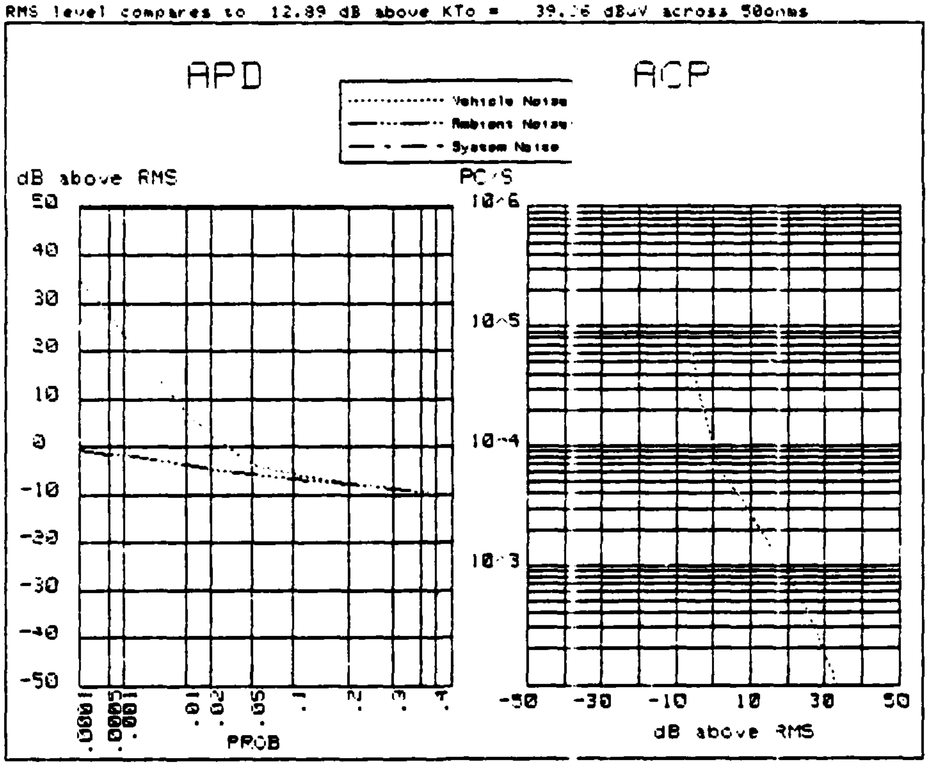


Figure 3-19. APD/ACR data plots for test 11 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST 12

TEST SETUP DATA:

08/21/79 (M/D/Y)
21:57:43 (H:M:S)

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	DIPOLE AC-105 / IT

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	100 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC S	dBrms
1	.0001	240E-01	31.2
2	.0005	840E-01	24.2
3	.0010	236E+00	17.3
4	.0100	175E+01	3.4
5	.0200	548E+01	1.5
6	.0500	163E+02	-.5
7	.1000	239E+02	-1.5
8	.2000	422E+02	-3.5
9	.3000	482E+02	-4.5
10	.4000	523E+02	-5.5

Cal. RMS	Vavg	Vd	Vp	Noise P.
51.7dBuV	20.6dBuV	4.6dB	61.1dBuV	-84.8dBm

$\hat{V}_v = 26.5$ dB(μV) $\hat{V}_a = 20.1$ dB(μV)

$V_{amb} = 19.9$ dB(μV)

$\Omega_{2B}^{(G)} \doteq$?

RMS level compares to 8.46 dB above KTo = 25..8 dBuV across 50ohms

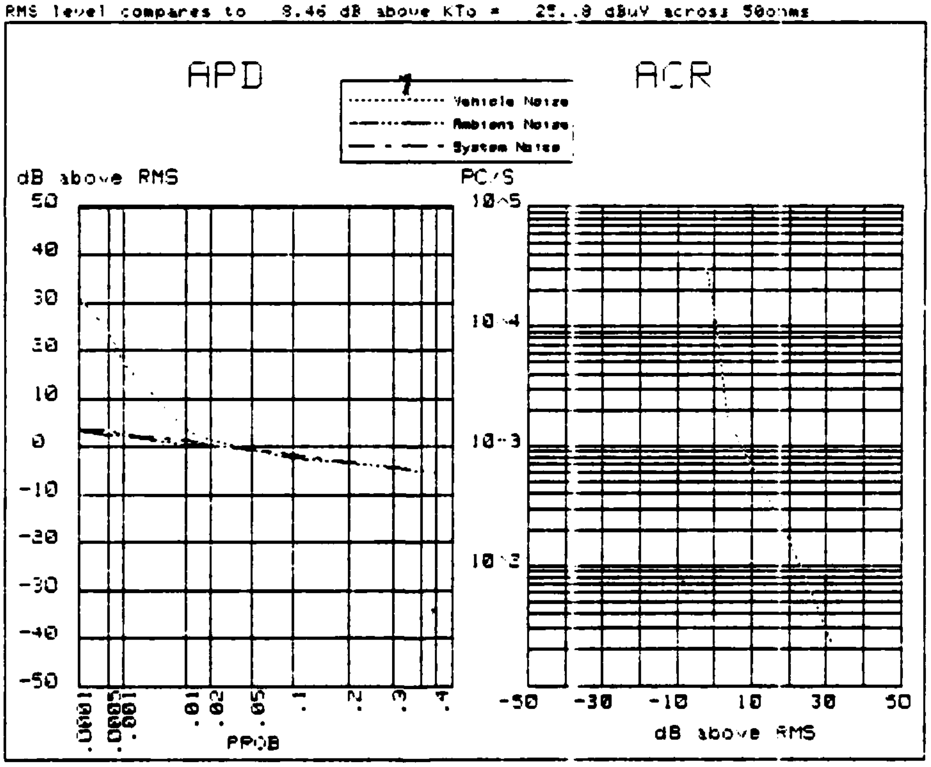


Figure 3-20. APD/ACR data plots for test 12 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST — 13 — 08/21/79 (M/D/Y) 22:20:53 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	DIPOLE AC-105 KIT

TEST CODE: 16   VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC S	dBrms
1	.0001	560E-01	34.0
2	.0005	258E+00	24.1
3	.0010	448E+00	19.1
4	.0100	644E+01	5.3
5	.0200	105E+02	4.3
6	.0500	374E+02	2.3
7	.1000	601E+02	1.3
8	.2000	110E+03	-.7
9	.3000	130E+03	-1.7
10	.4000	143E+03	-2.7

Cal. RMS	Vavg	Vd	Vp	Noise P.
56.4dBuV	24.9dBuV	2.4dB	64.2dBuV	-82.7dBm

$\hat{V}_v$ = 32.2 dB(μV) $\hat{V}_a$ = 25.0 dB(μV)

V_{amb} = 24.9 dB(μV)

$\Omega_{2B}^{(G)} \doteq ?$

RMS level compares to 5.39 dB above kTo = 27.31 dBuV across 50ohms

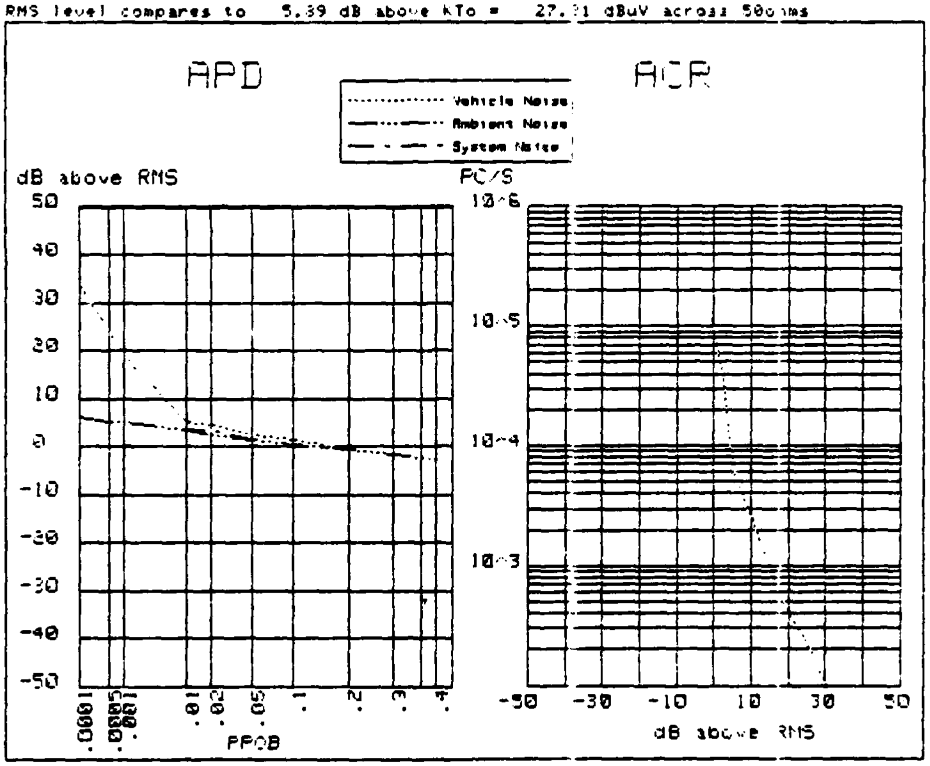


Figure 3-21. APD/ACR data plots for test 13 and test code 16 with Rayleigh ambient.

3.2 STATISTICS OF THE NOISE PARAMETERS

3.2.1 IF Envelope Statistics and Sample Cumulative Distributions

The sample median, mean, and standard deviations of the various noise parameters for all single-vehicle tests are tabulated in table 3-II. Typical sample cumulative distribution plots of V_p, V_{rms}, and V_v are shown in figures 3-22 through 3-33 for each frequency, and figure 3-34 shows plots of the distribution of $V_a - V_v$. For the latter, all bandwidths were included for each frequency. The scaling along the ordinate of the distribution plots is Gaussian; that is, if a distribution were truly Gaussian, it would appear as a straight line.

No analyses were performed on the average envelope noise power, P_N. Since the IF output impedance was 50 ohms, P_N can be easily calculated from

$$P_N = V_{rms} - 107 \qquad \text{(dBm)} \qquad (3\text{-}37)$$

(Ref figure 7 in the main body of this report.)

It has the same standard deviation as V_{rms}; and its sample means and medians are easily computed from equation 3-37, so a separate analysis of P_N data would have been redundant. If one intends P_N to be the noise power in the IF measured into a 50-ohm load, one should subract 3 dB from the value given in equation 3-37 (ref equation 3-15).

3.2.2 Relating Envelope Parameters to RF Input and Field Strength

The envelope dB(μV) parameters can be referred back to the RF input by subtracting the receiver noise gain. One must not think of such adjusted values as actual, directly measurable quantities, however, because they are functions of the IF bandwidth. Noise gain of the receiver was measurable in these tests by employing the calibrated noise source, which had a calibrated noise figure. In the raw data plots, the value of the calibration noise rms envelope is listed, in dB(μV). If we call this value $V_{c\ rms}$, then receiver noise gain may be computed from

$$G_n = V_{c\ rms} - F_c - 10 \log kT - 10 \log b_{Hz} - 107$$

$$\simeq V_{c\ rms} - F_c - 10 \log b_{kHz} + 37 \qquad (3\text{-}38)$$

(Text continued on page 3-50)

TABLE 3-II. STATISTICS OF SINGLE-VEHICLE NOISE PARAMETERS (IF ENVELOPE VALUES IN dB(μV)

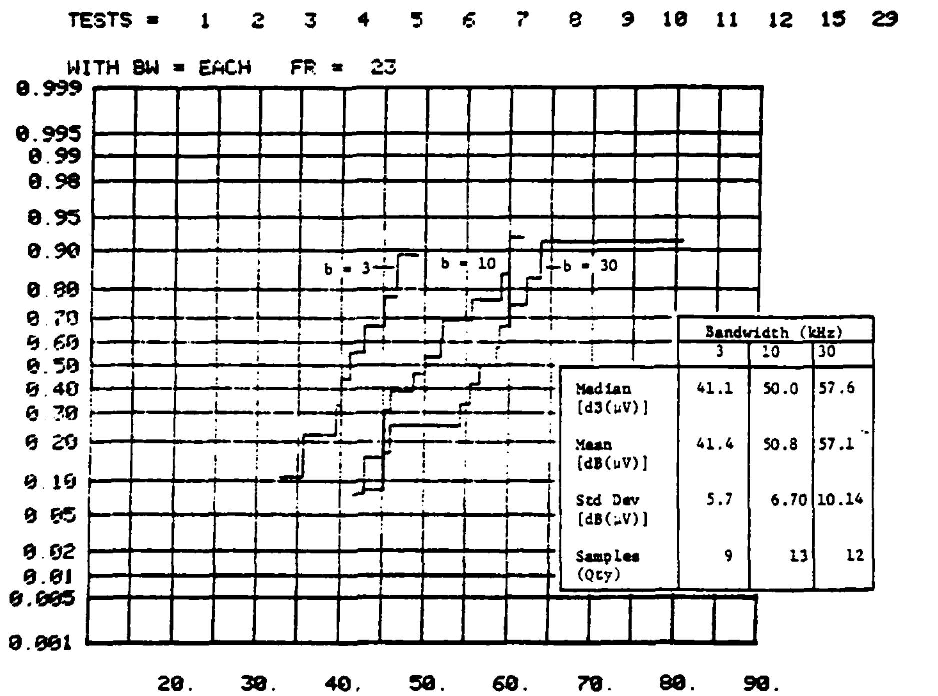
Freq (MHz)	Bandwidth	Parameter	Median	Mean	Std Dev
23	3	V_p	41.1	41.4	5.2
		V_{rms}	34.3	33.5	6.5
		V_{av}	34.0	32.3	6.7
		V_v	25.4	25.7	3.9
	10	V_p	50.0	50.8	6.7
		V_{rms}	39.2	40.9	9.5
		V_{av}	38.6	39.9	9.8
		V_v	28.2	28.8	5.3
	30	V_p	57.6	57.1	10.1
		V_{rms}	40.8	41.9	8.2
		V_{av}	39.8	41.1	8.7
		V_v	30.3	31.6	5.4
75	3	V_p	32.4	32.6	5.7
		V_{rms}	20.9	21.0	3.2
		V_{av}	18.6	19.9	3.6
		V_v	16.3	17.9	5.7
	10	V_p	37.8	40.3	8.0
		V_{rms}	22.2	23.8	2.9
		V_{av}	20.9	22.2	3.2
		V_v	18.1	19.3	4.5
	30	V_p	47.4	47.3	9.7
		V_{rms}	29.3	27.8	3.0
		V_{av}	26.1	26.0	2.6
		V_v	22.2	23.0	6.1

TABLE 3-II. STATISTICS OF SINGLE-VEHICLE NOISE PARAMETERS (IF ENVELOPE VALUES IN dB(μV)) (CONT).

Freq	Bandwidth	Parameter	Median	Mean	Std Dev
	100	V_p	53.9	57.0	11.6
		V_{rms}	30.9	31.0	2.3
		V_{av}	28.9	29.0	1.9
		V_v	26.7	27.3	6.6
	300	V_p	66.1	63.0	12.1
		V_{rms}	34.2	34.3	2.5
		V_{av}	31.7	32.0	1.5
		V_v	29.6	30.6	7.0
300	10	V_p	44.7	44.1	8.3
		V_{rms}	23.2	23.0	3.3
		V_{av}	17.7	17.5	1.2
		V_v	22.4	21.8	4.2
	30	V_p	57.8	56.9	7.8
		V_{rms}	29.0	28.1	3.7
		V_{av}	22.3	22.0	1.3
		V_v	27.4	25.9	5.9
	100	V_p	66.1	63.6	10.3
		V_{rms}	32.4	32.4	3.8
		V_{av}	26.2	26.0	1.2
		V_v	32.5	30.8	6.3
	300	V_p	74.5	73.1	8.8
		V_{rms}	35.3	36.0	4.5
		V_{av}	30.7	30.4	1.1
		V_p	36.3	37.0	7.2

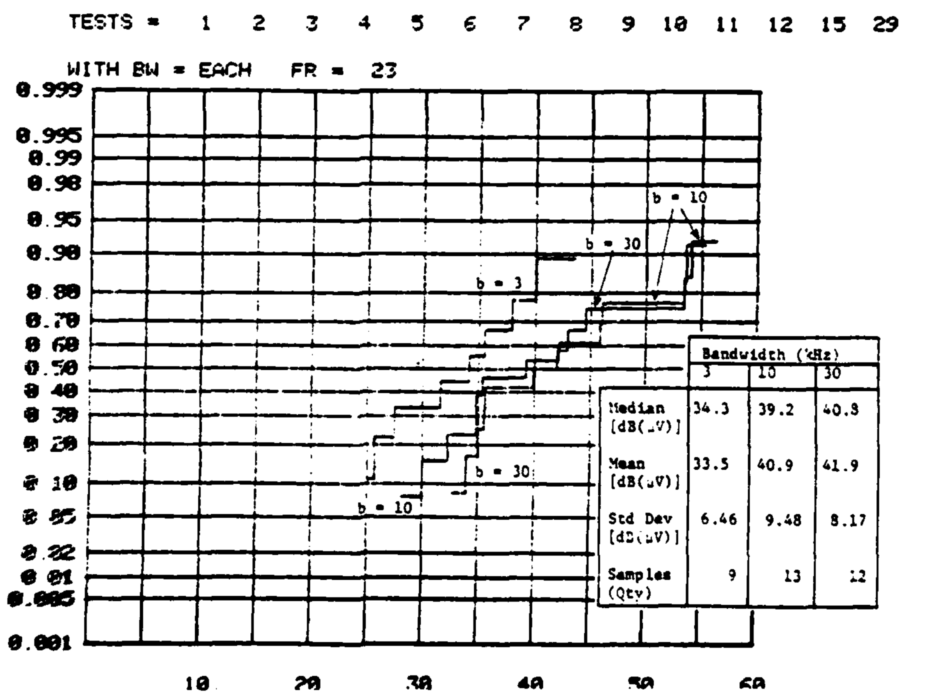
TABLE 3-II. STATISTICS OF SINGLE-VEHICLE NOISE PARAMETERS (IF ENVELOPE VALUES IN dB(μV)) (CONT).

Freq	Bandwidth	Parameter	Median	Mean	Std Dev
900	100	V_p	49.7	48.6	7.7
		V_{rms}	21.5	21.5	1.6
		V_{av}	19.1	19.2	0.6
		V_v	20.3	18.6	7.2
	300	V_p	63.6	58.1	10.0
		V_{rms}	25.7	26.9	3.0
		V_{av}	23.7	24.1	1.2
		V_v	26.7	26.7	11.6



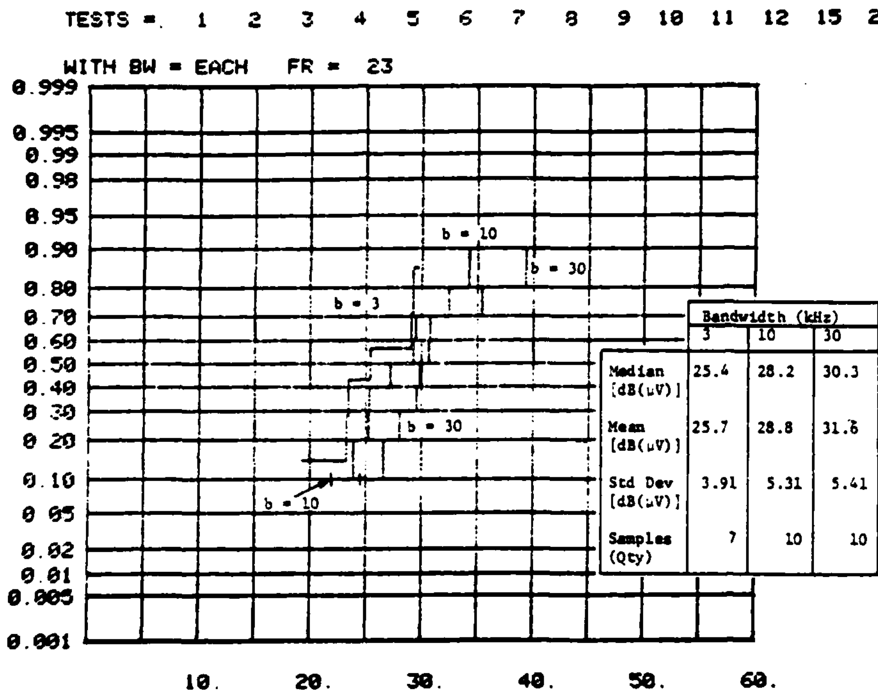
	Bandwidth (kHz)		
	3	10	30
Median [dB(μV)]	41.1	50.0	57.6
Mean [dB(μV)]	41.4	50.8	57.1
Std Dev [dB(μV)]	5.7	6.70	10.14
Samples (Qty)	9	13	12

Figure 3-22. Sample cumulative distribution of V_p with noise parameter at IF output (23 MHz).



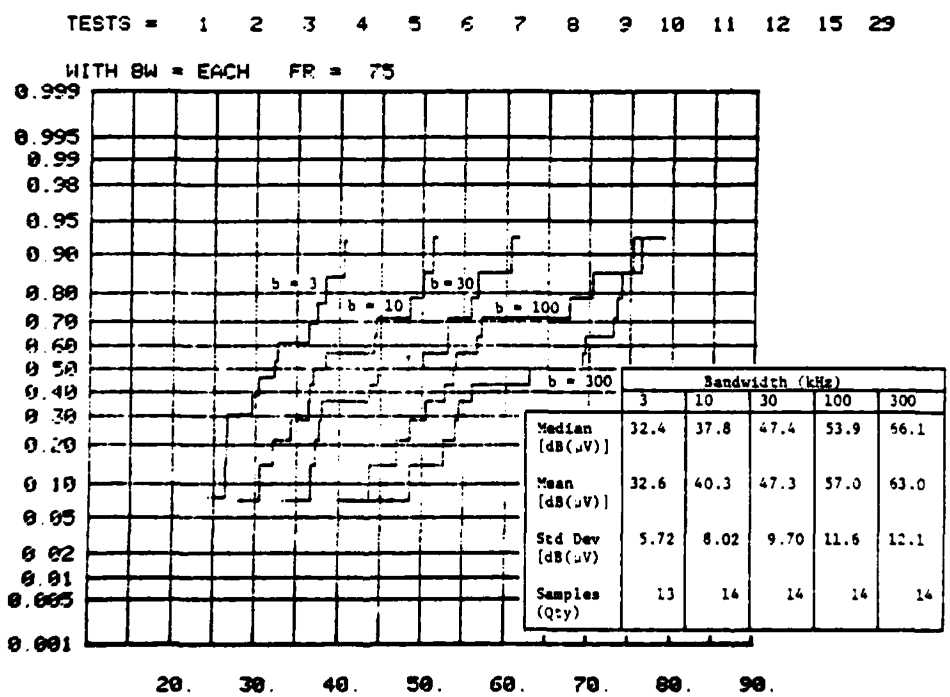
	Bandwidth (kHz)		
	3	10	30
Median [dB(μV)]	34.3	39.2	40.8
Mean [dB(μV)]	33.5	40.9	41.9
Std Dev [dB(μV)]	6.46	9.48	8.17
Samples (Qty)	9	13	12

Figure 3-23. Sample cumulative distribution of V_{rms} with noise parameter at IF output (23 MHz).



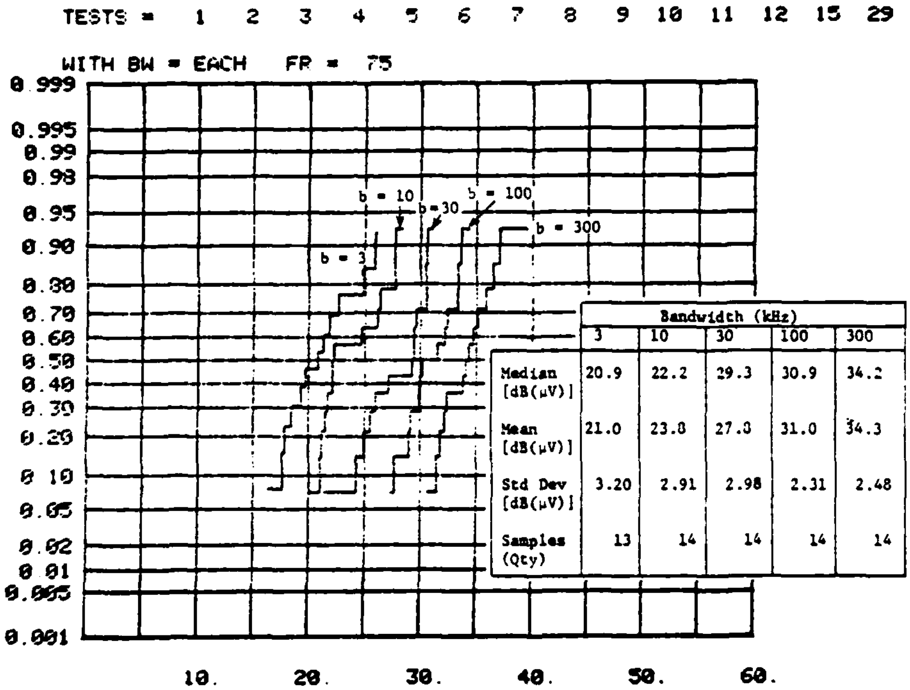
	Bandwidth (kHz)		
	3	10	30
Median [dB(μV)]	25.4	28.2	30.3
Mean [dB(μV)]	25.7	28.8	31.6
Std Dev [dB(μV)]	3.91	5.31	5.41
Samples (Qty)	7	10	10

Figure 3-24. Sample cumulative distribution of V_v with noise parameter at IF output (23 MHz).



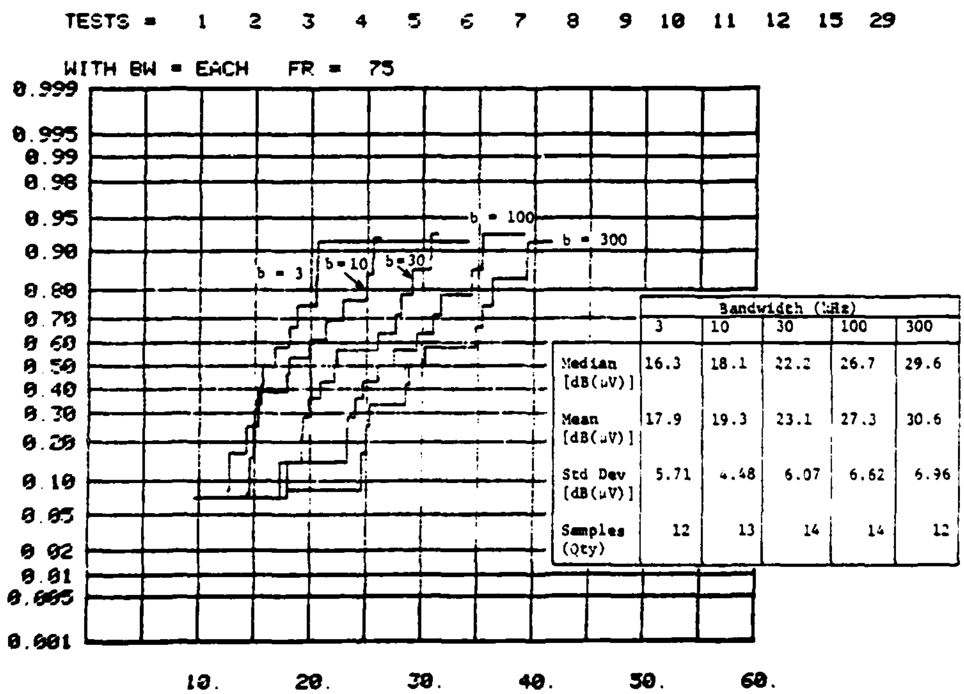
	Bandwidth (kHz)				
	3	10	30	100	300
Median [dB(μV)]	32.4	37.8	47.4	53.9	56.1
Mean [dB(μV)]	32.6	40.3	47.3	57.0	63.0
Std Dev [dB(μV)	5.72	8.02	9.70	11.6	12.1
Samples (Qty)	13	14	14	14	14

Figure 3-25. Sample cumulative distribution of V_p with noise parameter at IF output (75 MHz).



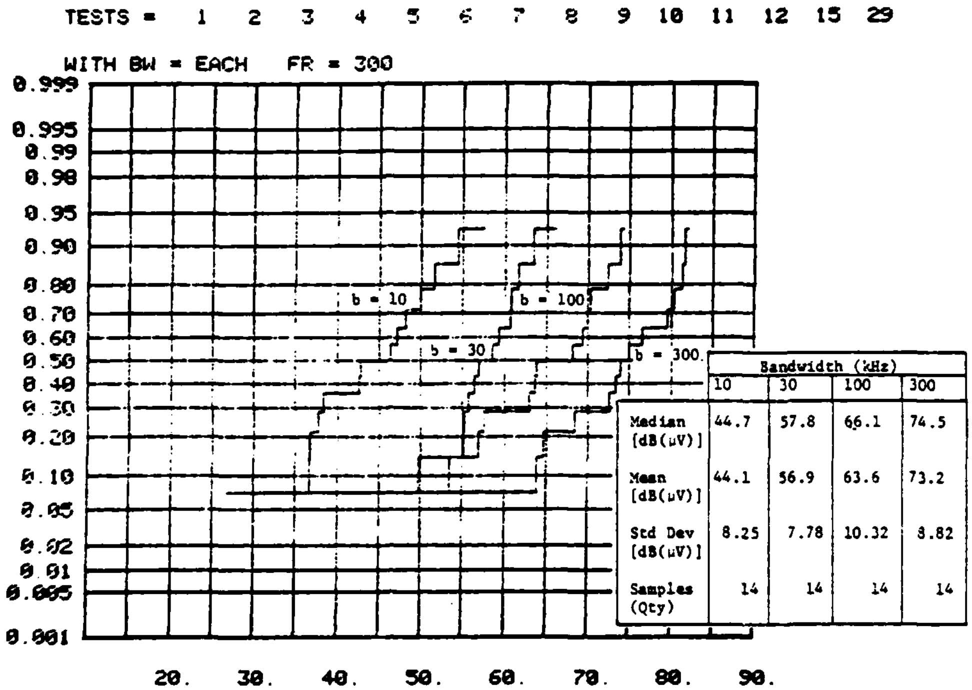
	Bandwidth (kHz)				
	3	10	30	100	300
Median [dB(μV)]	20.9	22.2	29.3	30.9	34.2
Mean [dB(μV)]	21.0	23.8	27.0	31.0	34.3
Std Dev [dB(μV)]	3.20	2.91	2.98	2.31	2.48
Samples (Qty)	13	14	14	14	14

Figure 3-26. Sample cumulative distribution of V_{rms} with noise parameter at IF output (75 MHz).



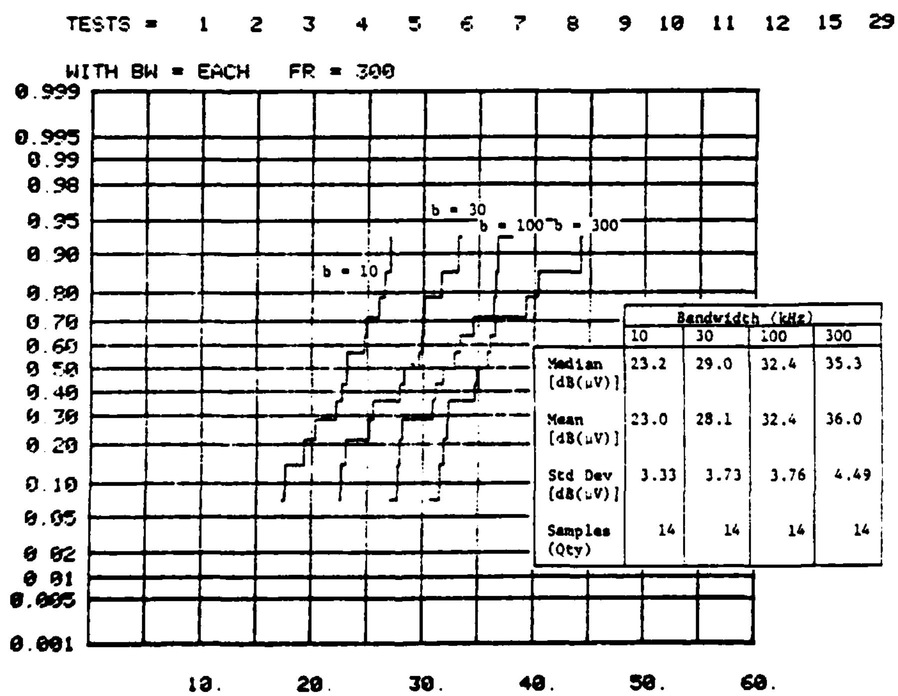
	Bandwidth (kHz)				
	3	10	30	100	300
Median [dB(μV)]	16.3	18.1	22.2	26.7	29.6
Mean [dB(μV)]	17.9	19.3	23.1	27.3	30.6
Std Dev [dB(μV)]	5.71	4.48	6.07	6.62	6.96
Samples (Qty)	12	13	14	14	12

Figure 3-27. Sample cumulative distribution of V_v with noise parameter at IF output (75 MHz).



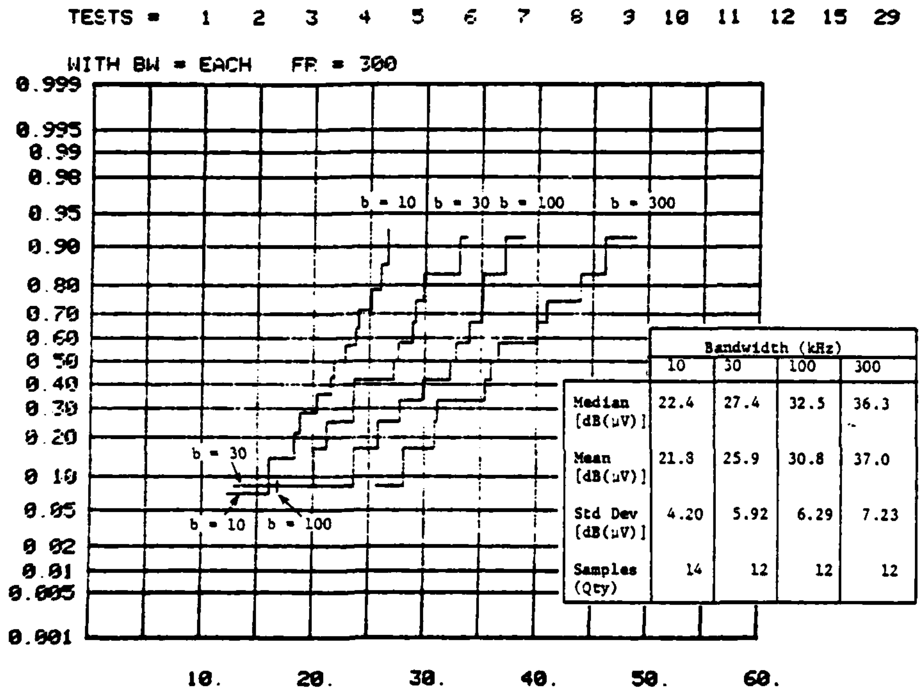
	Bandwidth (kHz)			
	10	30	100	300
Median [dB(μV)]	44.7	57.8	66.1	74.5
Mean [dB(μV)]	44.1	56.9	63.6	73.2
Std Dev [dB(μV)]	8.25	7.78	10.32	8.82
Samples (Qty)	14	14	14	14

Figure 3-28. Sample cumulative distribution of V_p with noise parameter at IF output (300 MHz).



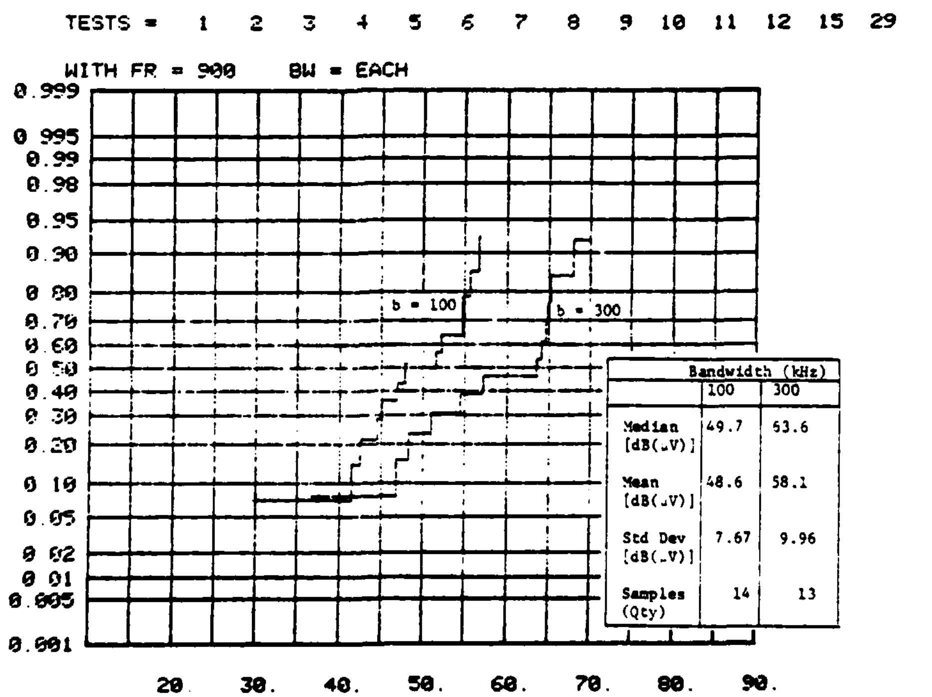
	Bandwidth (kHz)			
	10	30	100	300
Median [dB(μV)]	23.2	29.0	32.4	35.3
Mean [dB(μV)]	23.0	28.1	32.4	36.0
Std Dev [dB(μV)]	3.33	3.73	3.76	4.49
Samples (Qty)	14	14	14	14

Figure 3-29. Sample cumulative distribution of V_{rms} with noise parameter at IF output (300 MHz).



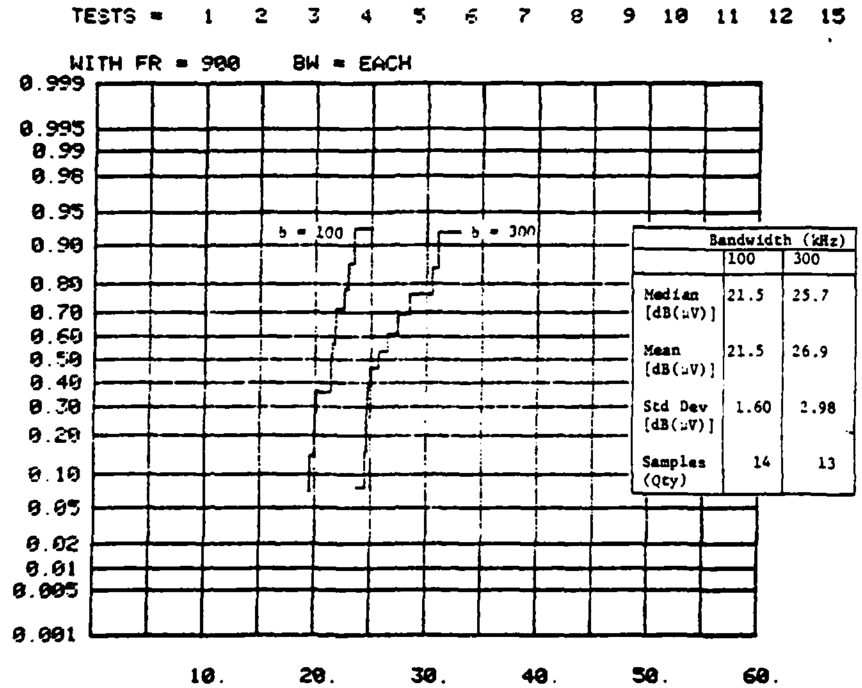
	Bandwidth (kHz)			
	10	30	100	300
Median [dB(μV)]	22.4	27.4	32.5	36.3
Mean [dB(μV)]	21.8	25.9	30.8	37.0
Std Dev [dB(μV)]	4.20	5.92	6.29	7.23
Samples (Qty)	14	12	12	12

Figure 3-30. Sample cumulative distribution of V_v with noise parameter at IF output (300 MHz).



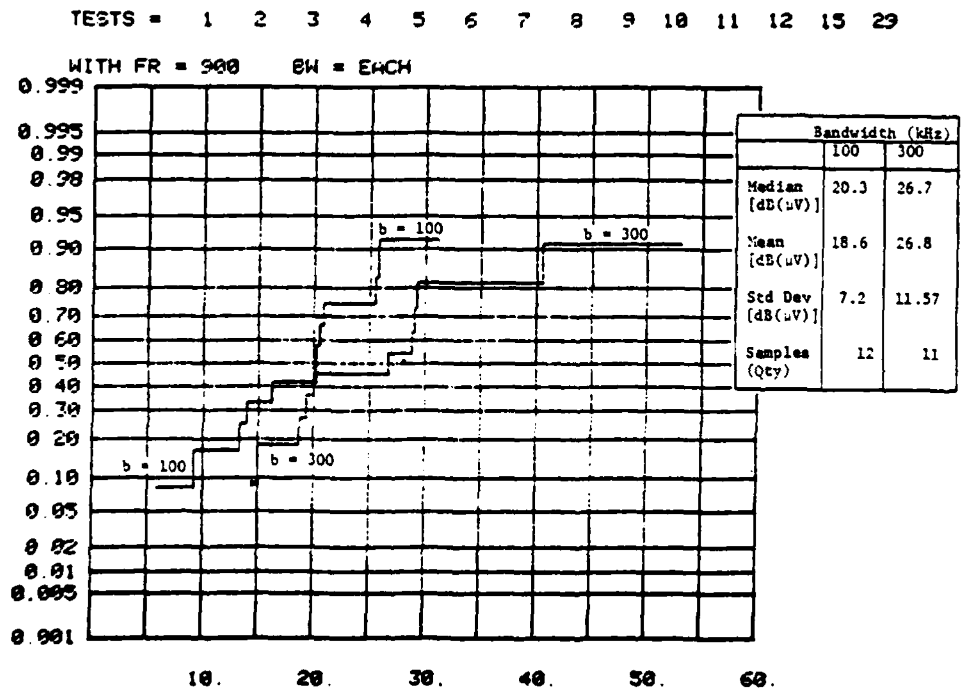
	Bandwidth (kHz)	
	100	300
Median [dB(μV)]	49.7	63.6
Mean [dB(μV)]	48.6	58.1
Std Dev [dB(μV)]	7.67	9.96
Samples (Qty)	14	13

Figure 3-31. Sample cumulative distribution of V_p with noise parameter at IF output (900 MHz).



	Bandwidth (kHz)	
	100	300
Median [dB(μV)]	21.5	25.7
Mean [dB(μV)]	21.5	26.9
Std Dev [dB(μV)]	1.60	2.98
Samples (Qty)	14	13

Figure 3-32. Sample cumulative distribution of V_{rms} with noise parameter at IF output (900 MHz).



	Bandwidth (kHz)	
	100	300
Median [dB(μV)]	20.3	26.7
Mean [dB(μV)]	18.6	26.8
Std Dev [dB(μV)]	7.2	11.57
Samples (Qty)	12	11

Figure 3-33. Sample cumulative distribution of V_v with noise parameter at IF output (900 MHz).

where

k = Boltzmann's constant = 1.380×10^{-20} mW/HzK

T = temperature in K (288 K)

F_c = noise figure of the calibrated noise source

(Note: Here, and here only in this appendix, are k and K used to mean other than Weibull distribution parameters.)

Average values of G_n for each test frequency are given in table 3-III. The calculated G_n values displayed very little variability.

The manufacturer's antenna factor (A_f) data in dB for the various test antennas were used to calculate the field strength of the emission by the relation

$$E = A_f + V \qquad \text{dB}(\mu V)$$

where E is the electric field strength in dB(μV/m) and V is the recorded detector voltage in dB(μV). Antenna factors for antennas used in the multiple-vehicle tests are given in table 3-IV.

The antennas used for the single-vehicle test were different from those used in the multiple-vehicle test except at 23 MHz. To make the two sets of data commensurate, a correction term, Δ, must be added to the single-vehicle noise terms. Values of Δ are given in table 3-V. These values were obtained from manufacturers' data, except for the value at 75 MHz, which was actually measured.

Care must be taken when referencing envelope parameters back to field strength to ensure that the noise parameter truly is dominated by noise entering via the antenna, and not by receiver noise. (One advantage of real-time APD plotting, such as performed in this study, is that it is readily apparent when receiver noise dominance occurs.)

3.2.3 Single-Vehicle Regression Analyses

3.2.3.1 Noise Parameters Versus Frequency and Bandwidth

Linear regressions of the noise parameters [V_p, V_{av}, V_{rms}, V_v, V_a] versus log b were run, and the results may be found in table VI of the main body of this report, with plots given in section 3.8 of this appendix. The noise parameters in the regression equations are referenced to the RF input for the type of antennas used in the multiple-vehicle tests (see section 3.2.2, above). This was done for ease of comparison of results at different frequencies with typical nondirectional antennas. A bivariate linear regression on each of the parameters versus log f and log b was also performed. For these regressions, the noise parameters were referenced to field strength [db(μV/m)]. The results of this analysis are given in table VII of the main body of the report. As

TABLE 3-III. RECEIVER NOISE GAIN AT THE FOUR TEST FREQUENCIES

Freq. (MHz)	23	75	300	900
Gn (dB)	40.5	40.0	40.0	33.0

TABLE 3-IV. ANTENNA FACTORS

Freq. (MHz)	23	75	300	900
A_f (dB)	11.6	7.6	17.9	27.5

TABLE 3-V. SINGLE-VEHICLE DATA TO MULTIPLE-VEHICLE DATA GAIN CORRECTION TERM

Freq. (MHz)	23	75	300	900
Δ (dB)	0.	9.2	-4.5	-4.5

indicated in the table, the regression equations for V_a, V_{av}, and V_{rms} are applicable only for the lower frequencies. This is because the ambient component tends to dominate these terms (see below), and the ambient noise was essentially receiver noise at the higher frequencies. The equations for these parameters are somewhat biased even at the lower frequencies, because the few cases where the ambient line had a Rayleigh slope were excluded from consideration.

3.2.3.2 Relationships Among Noise Parameters

On the basis of the definition of the various noise envelope parameters, one expects a high degree of correlation between certain parameters. For example, the envelope average (V_{av}) and the point on the APD plot at P = 0.4 ($R_{0.4}$) should be highly correlated with the ambient component (V_a). V_{av} is highly correlated with V_a due to the low duty cycle of vehicular noise (see also ref 14). For a Rayleigh slope on the ambient line, the APD value at P = 0.37 (1/e) equals V_a; and for "flatter" slopes, the value at V_a moves out toward higher probabilities. Thus, one would expect $R_{0.4}$ to be very nearly equal to V_a. Similarly, V_p is dominated by the vehicular component, and one would expect a fairly high correlation between V_p and V_v and $R_{0.0001}$, where $R_{0.0001}$ is the value on the APD plot at P = 0.0001. Any relationship between V_p and V_v should depend on bandwidth, since V_p varies as 20 log b (at least approximately), while V_v varies approximately as 10 log b. However, the relationship between V_p and $R_{0.0001}$ should not be highly sensitive to bandwidth. These expectations were tested by regression analyses, on all single-vehicle data, summarized in table 3-VI. Bandwidth was found to have a significant effect only when V_p is one of the variables, and was not significant in the $R_{0.0001}$ versus V_p regression.

TABLE 3-VI. RELATIONSHIPS BETWEEN NOISE PARAMETERS - ALL SINGLE-VEHICLE TESTS

Regression Equation (dB(μV) at RF)	Correlation Coeff	Std Error of Est
$\hat{V}_{rms} = 0.39 + 0.796\ V_a$	0.901	2.57
$\hat{V}_{av} = 0.88 + 0.941\ V_a$	0.996	0.77
$\hat{R}_{0.4} = 0.33 + 1.03\ V_a$	0.993	0.35
$\hat{R}_{0.0001} = 7.28 + 0.6\ V_p$	0.843	5.01
$\hat{V}_v = 18.8 + 0.50\ V_p$	0.745	5.82
$= 15.0 + 0.61\ V_p - 3.5 \log b$	0.770*	5.58
$\hat{V}_p = 21.2 + 0.795\ V_{rms}$	0.515	11.21
$= 1.43 + 0.679\ V_{rms} + 11.9 \log b$	0.791*	8.04
$V_v = 4.7 + 0.833\ V_{rms}$	0.777	5.29
$\hat{V}_{av} = -2.34 + 1.007\ V_{rms}$	0.957	2.80
$V_d = 0.062 + 0.126\ (V_p - V_{rms})$	0.498	2.49
$V_d = 3.55 + 0.0212\ (V_v - V_{rms})$	0.434	2.49

* Values for the multiple correlation coefficient for the bivariate analysis.

3.3 VOICE COMMUNICATION SYSTEM PERFORMANCE

3.3.1 Relating NATE Receiver Envelope Parameters to RF Levels at the Communication Receiver

The RF section of the NATE receiver provided signals which were summed with signals from the desired transmitter and were fed into the RF input of the test receiver. A variable attenuator on the line allowed setting for 0-dB gain between the NATE receiver input and the test receiver input. This gain calibration was performed with CW signals, and lead to attenuation values given in table 3-VII.

TABLE 3-VII. ATTENUATOR SETTINGS FOR ZERO-dB GAIN FROM NATE RECEIVER TO TEST RECEIVER

Freq (MHz)	23	75	300	900
Attenuation (dB)	25	23	21	15

Envelope parameters were referenced back to RF input, as described in Section 3.2. The assumption was made that the same values were then applicable at the input to the test receiver. It was further assumed that envelope statistics in the test receiver IF could be represented by statistics of the envelope in the NATE receiver, when the values were determined at an IF bandwidth that most nearly matched the bandwidth of the test receiver.

These assumptions have several drawbacks:

(1) NATE receiver noise was fed into the test receiver. If the ambient is dominated by receiver noise, the ambient in the test receiver is dominated by either NATE or test receiver noise, depending on which one has the greater noise factor.

(2) As a corollary to the above, V_{rms} and V_{av}, which tend to be dominated by the ambient level, may or may not be representative of values for the test receiver IF envelope.

(3) The RF amplifier in the test receiver cannot be expected to have the same dynamic range and frequency response as the NATE receiver. To the extent that a receiver's RF stages affect the APD, the impulsive components in the test receiver may or may not be similar to those in the NATE receiver.

(4) The slope of the vehicular line on an APD plot is in part determined by the IF bandwidth of the receiver. Thus, differences in bandwidths and frequency response between the two receivers will give different slopes, i.e., different values of m_v. As can be seen from the nomogram in figure 3-1, when m_v is small (on the order of 0.1), small changes in slope reflect into large changes in V_v.

(5) The cable carrying RF signals from the NATE to the test receiver filters transient signals. Thus, different RF noise levels from transients will appear at the test receiver than were present in the NATE.

3.3.2 Results

3.3.2.1 Performance Measures versus Signal Level and Signal-to-Noise Ratio

a. Introduction

Plots of performance in terms of articulation score (AS) versus signal-to-noise ratio ($S\text{-}V_{rms}$ in dB) are given in figures 13 through 16 in the main body of this report. Average signal power levels at RF input were converted to dB(μV) by adding 107 dB to their values expressed in dBm. V_{rms} is an envelope parameter, referenced back to RF by subtracting the noise gain between NATE receiver input and envelope output from the envelope values. For signal-to-noise ratios in the IF, 3 dB must be added to the $S\text{-}V_{rms}$ values (because the envelope rms is 3 dB greater than the rms of the IF voltage). Plots of AI versus $S\text{-}V_{rms}$ for the various system types are given in figures 3-35 through 3-38; the corresponding AS plots are given in figures 13 through 16 of the main body of the report and plots of the raw APD data for the tests are given in figures 3-40 through 3-63.

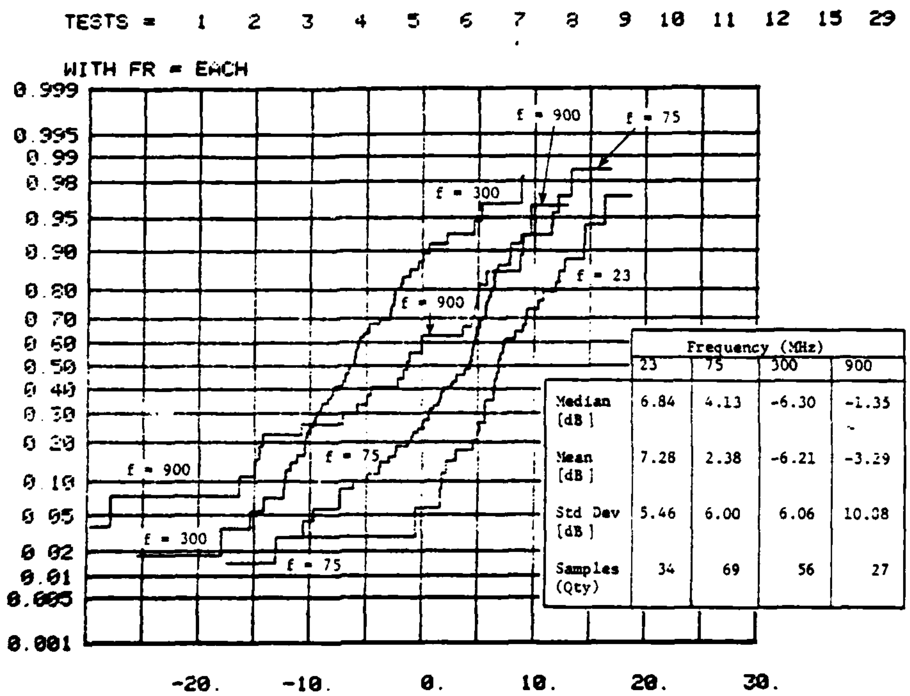
b. SSB System

From figure 3-35, it would seem that any amount of vehicular noise is very degrading to the SSB system, but such is not the case. It happened that during the no-vehicle test, the system was subjected to a high level of ambient interference, which was essentially CW (see table V in the main body). SSB systems can pass speech intelligibly at quite low signal-to-CW-interference levels. In the tests with vehicles, the ambient levels were lower and more nearly Rayleigh, and the curves of AS and AI versus $S\text{-}V_{rms}$ are tightly grouped. The range of V_d values for these tests was only 1.2 to 3.1, which probably accounts for the closeness of the data points.

c. AM System

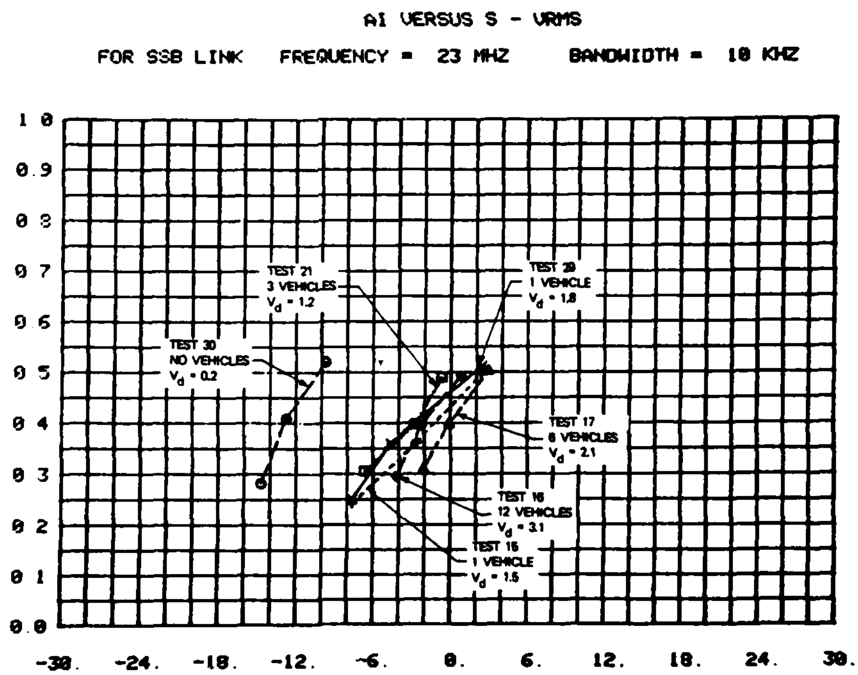
The AI versus $S\text{-}V_{rms}$ plot for the AM system (figure 3-37) shows a distinctive shift of the curves to the left when vehicular noise is present. This is in agreement with other findings (ref 6) and indicates that impulsive interference at a given rms level is less degrading to intelligibility than is steady Gaussian noise. (The ambient noise was essentially Gaussian for the AM system.) The extreme difference between test 29 and test 15, both involving one vehicle, can be explained as follows. In test 29, the noise from the NATE receiver was amplified before entering the AM receiver. If the noise factor of the AM receiver was much greater than that of the NATE, the effect would be to increase the impulsive (vehicular) components at the AM detector with little or no change to the Gaussian component. This is apparently what happened. Thus, the V_d values at the AM detector were probably much lower than the measured NATE values shown in figure 3-37 for tests 15 through 21.

(Text continued on page 3-59)



	Frequency (MHz)			
	23	75	300	900
Median [dB]	6.84	4.13	-6.30	-1.35
Mean [dB]	7.28	2.38	-6.21	-3.29
Std Dev [dB]	5.46	6.00	6.06	10.38
Samples (Qty)	34	69	56	27

Figure 3-34. Sample cumulative distribution of $V_a - V_v$ with noise parameter at IF output.



31

Figure 3-35. AI versus S - V_{rms} (dB) for SSB communication system.

AI VERSUS S - VRMS

FOR FM LINK FREQUENCY = 75 MHZ BANDWIDTH = 30 KHZ

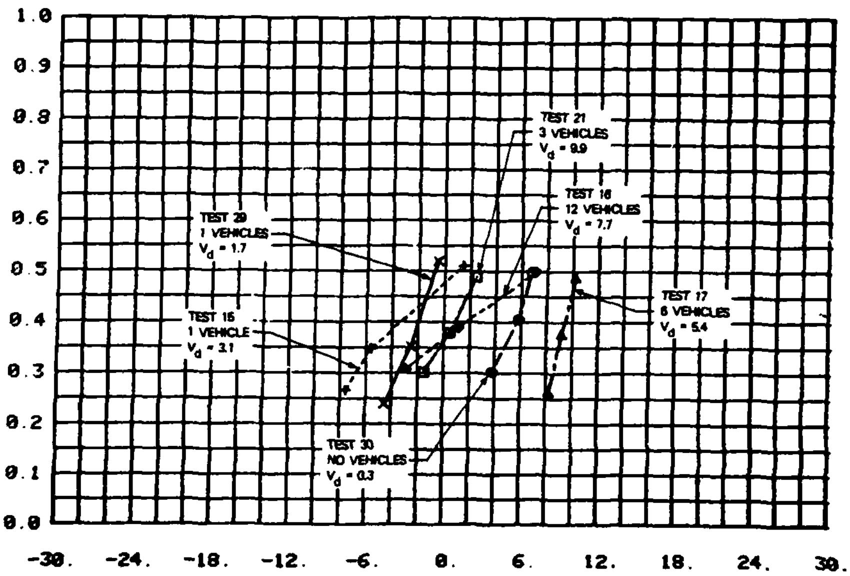


Figure 3-36. AI versus S - V_{rms} (dB) for FM voice system.

AI VERSUS S - VRMS

FOR AM LINK FREQUENCY = 300 MHZ BANDWIDTH = 30 KHZ

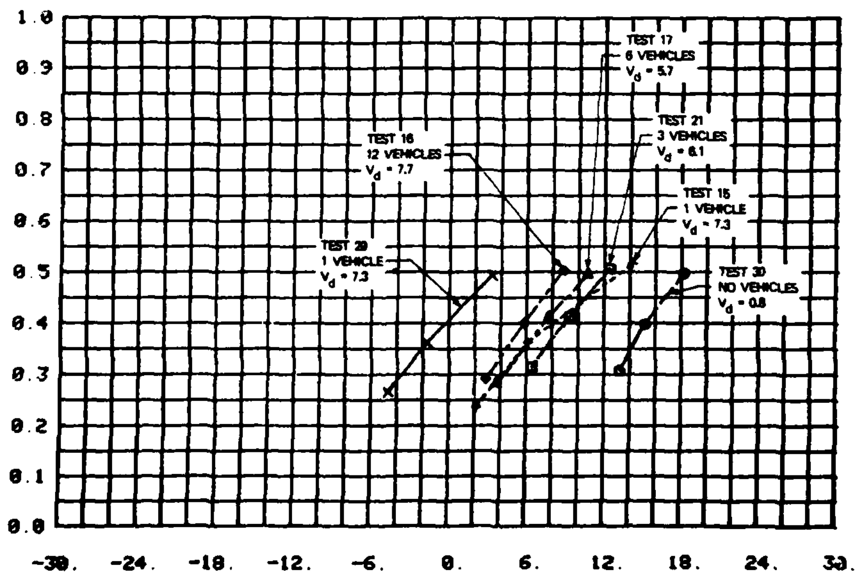


Figure 3-37. AI versus S - V_{rms} (dB) for AM communication system.

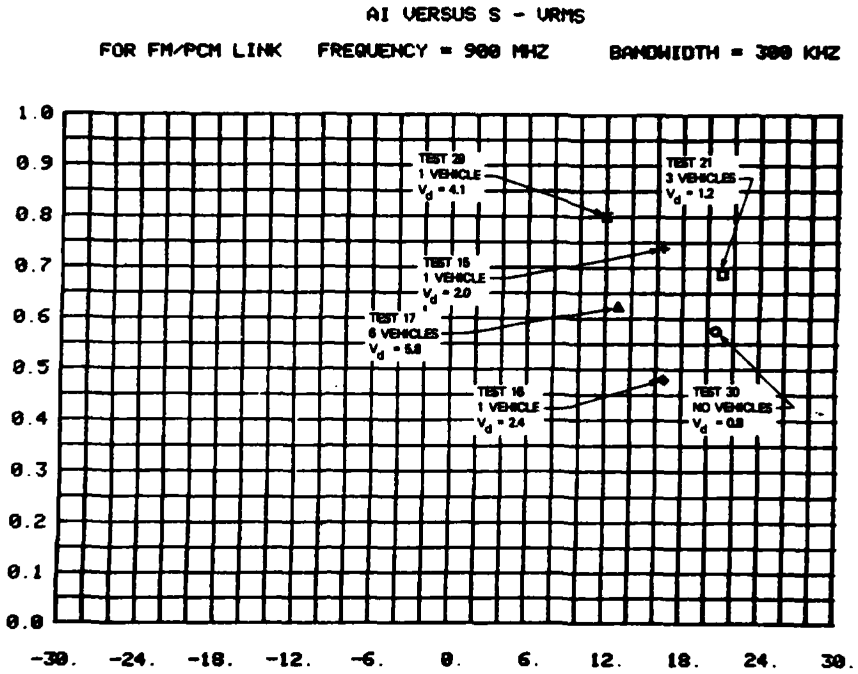


Figure 3-38. AI versus S - V_{rms}

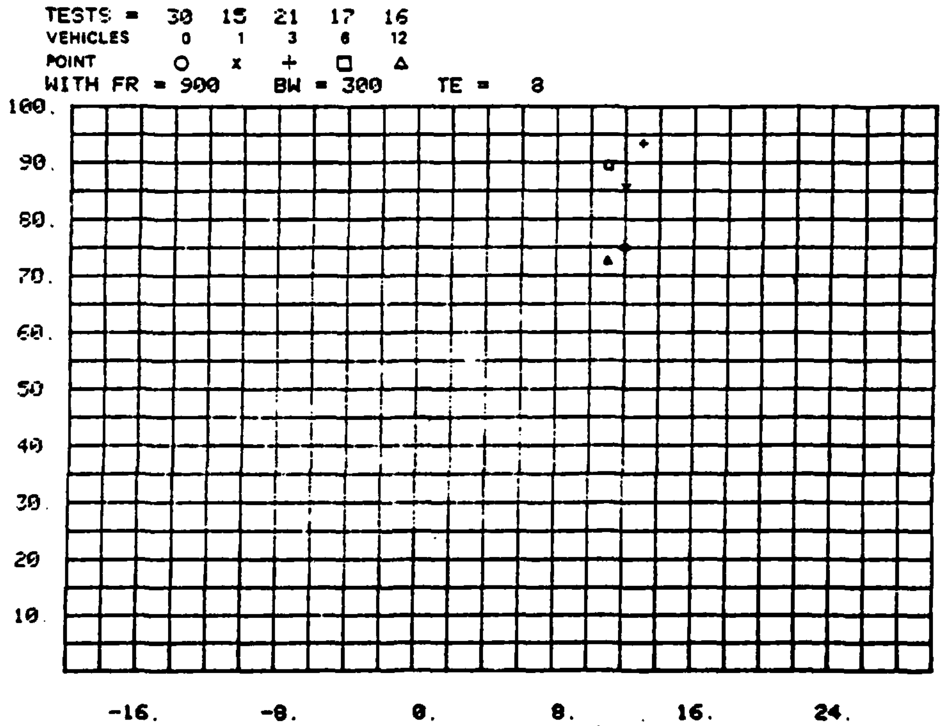


Figure 3-39. AS versus S [dB(μV)] for FM/PCM communication system.

Another point worthy of note is the high S-V_{rms} levels required for a reasonable level of intelligibility--considerably greater than 3 dB. This is because the AM receiver tested had an IF bandwidth considerably greater than its approximately 3.5-kHz audio bandwidth. Thus, much of the noise was filtered out by the audio circuits. This is a point to consider when interpreting IF or envelope signal-to-noise ratios.

d. FM/PCM System

Only one S level was tested on the FM/PCM link, since a range of intelligibility values could not be attained; the PCM decoder broke synchronization at a high AS level. The S level tested was 1 dB above loss of synchronization. Even 1 added dB of signal level brought the system up to virtually total intelligibility. As the AS- versus-S plot (figure 3-39) indicates, this break-synchronization threshold was within 1 dB of the level for no vehicles. Thus, the FM detector was impervious to the vehicular noise, and the AS and AI versus S-V_{rms} data (figures 14 in main body and 3-38) do not seem to be applicable, when V_{rms} is determined by the NATE system, with its high dynamic range.

e. FM Voice System

AI versus S-V_{rms} for the FM link is plotted in figure 3-36, with AS versus S-V_{rms} shown in figure 12 in the main body. With the exception of test 17, vehicular noise caused a shift of the curves toward lower S-V_{rms} values, similar to that observed for the AM system. Such a shift, together with a reduction in slope of the curves, was expected, based on previous FM tests with time-varying interference (ref 7). The slope reduction was observed only for test 15 (1 vehicle) and 16 (12 vehicles). The shift was greater for 1 vehicle than for 12, which is contrary to expectation. For test 29, the vehicular component was 3 dB below the ambient in the NATE system (table V in the main body), so the steepness of slope indicates that the ambient was probably dominant in determining intelligibility. There was an 8-dB shift in S-V_{rms} between the test 29 data and test 30 (no vehicles) data. This tends to indicate that the NATE receiver noise figure was considerably lower than for the FM receiver, so that the noise from the NATE had to be increased by several dB before any effect was observed at the FM detector.

The FM detector is preceded by a limiter, so the high-level, low-probability impulsive components, which contribute significantly to rms level in the NATE system, are treated the same as much lower level, higher probability components. Thus, signal-to-IF envelope noise ratio cannot be expected to have a totally consistent relationship to intelligibility for FM systems. Perhaps ACR (average crossing rate) at a level equal to desired signal level would be a more consistent indicator of intelligibility.

3.3.3 AS versus AI Relationships

Plots of AS versus AI, as obtained on the VIAS, are given in figures 15 (one curve for each system type) and 16 (one curve with all data combined) of the main body of the report. These regression curves were made by using

a transformation of AS values to a function form that has been found (ref 7) to give a good fit by linear regression. The function is of the form:

$$\widehat{AS} = i^{(\gamma)^{AI}} \tag{3-39}$$

With AS taken as a fraction rather than percentage, taking the natural log of both sides of the equation twice yields:

$$\ln [-\ln(\widehat{AS})] = AI \ln \gamma + \ln (-\ln i) \tag{3-40}$$

which is a linear equation in AI. The parameter i is termed the intercept parameter and γ the rate parameter.

As can be seen in figure 17 (main body), there is quite a bit of spread of AS data points about the regression lines for the SSB, FM, and AM systems. Some variation is to be expected because the AS scores were obtained with only one listener crew (8 listeners). However, it was discovered that tests tended to fall into families of curves for all three systems.

On the FM link there were two curves about which the data clustered: curve for 3 and 6 vehicles and a curve for the other tests. The two curves for the FM link are shown in figure 3-64. There were also essentially two curves for the AM system: one curve for the two single-vehicle tests (test codes 15 and 29) and another curve for the rest of the data.

On the SSB system there were essentially three curves. Tests with 3 vehicles and no vehicles made up one curve, the two tests with 1 vehicle made up a second curve, and tests with 6 and 12 vehicles made up still a third curve.

The distinction between the curves was noticeable not only by clustering of the data points, but by the shape of the curves: the slope parameters were distinctly different. Similar groupings of data had been noticed before (ref 7) when similar systems had been subjected to interference from communications transmitters, and it was found that the significant parameter was the degree of variability in the audio interference. The noise parameter V_d ($V_d = V_{rms} - V_{av}$) is an indicator of the degree of impulsiveness of the IF envelope, so V_d was examined as a possible parameter of the curves. The results were inconclusive, however.

There seems to be little pattern to the curve groupings, other than the separation of single-vehicle data on the AM and SSB links. Thus, the phenomenon is considered to be a relatively minor design deficiency in the VIAS as a predictor of AS.

THE SELECTED VEHICLES FOR TEST CODE 14 ARE NUMBE (S):

VEHICLE NOISE TEST 08/21/79 (M/D/Y)

TEST SETUP DATA: 1 09:11:24 (H:M:S)

VEHICLE DESCRIPTION	ANTENNA DESCRIPTION
N/A AS-AI TEST (CLEAR)	BICON

TEST CODE: 14 VEHICLES IN THE TEST: 0

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
23.5 MHz	10 kHz	1500 RPM	0 deg. 0 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	290E-01	4.3	43.0dBuV	40.[illegible]dBuV	.2dB	47.6dBuV	-68.9dBm
2	.0005	290E-01	4.3					
3	.0010	250E-01	4.3					
4	.0100	189E+00	3.3					
5	.0200	742E+00	2.3					
6	.0500	790E+00	2.3					
7	.1000	174E+01	1.3					
8	.2000	232E+01	.3					
9	.3000	242E+01	.3					
10	.4000	244E+01	-.6					

RMS level compares to 28.11 dB above KTo = 41.14 dBuV across 50ohms

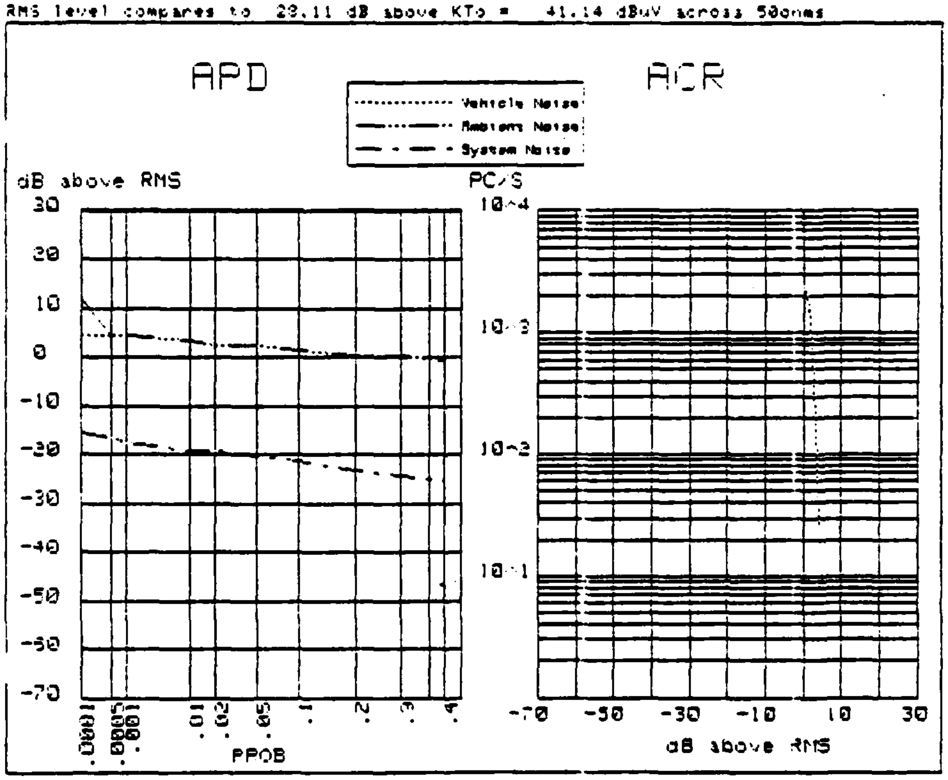


Figure 3-40. APD/ACR data plots for test 1 and test code 14 with Rayleigh ambient.

TEST SETUP DATA:

VEHICLE NOISE TEST
3

08/21/79 (M/D/Y)
10:59:14 (H:M:S)

VEHICLE DESCRIPTION	ANTENNA DESCRIPTION
N/A AS-AI TEST (CLEAR)	BICON

TEST CODE: 14   VEHICLES IN THE TEST: 0

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 0 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	600E-02	5.4	52.4dBuV	29.9dBuV	.3dB	37.8dBuV	-79.8dBm
2	.0005	880E-01	4.4					
3	.0010	226E+00	4.4					
4	.0100	323E+01	3.4					
5	.0200	394E+01	3.4					
6	.0500	599E+01	3.4					
7	.1000	149E+02	2.4					
8	.2000	138E+02	1.4					
9	.3000	233E+02	1.4					
10	.4000	235E+02	1.4					

Had unknown source of Ignition on the 1st (Ambient Noise) pass.

RMS level compares to 12.76 dB above KTo = 30.19 dBuV across 50ohms

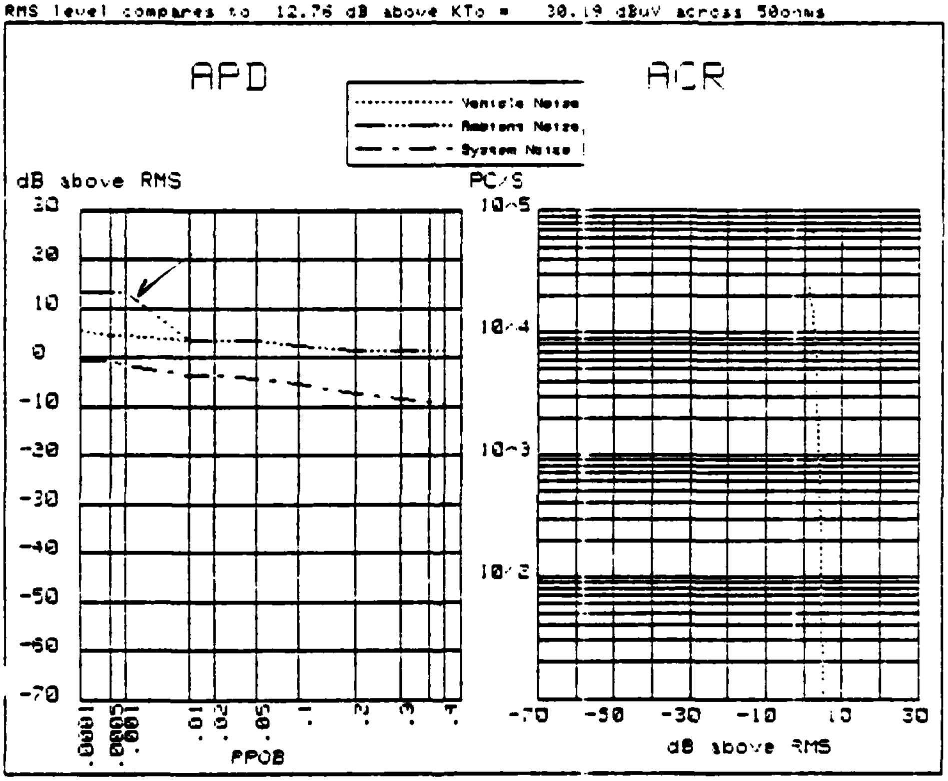


Figure 3-41. APD/ACR data plots for test 3 and test code 14 with Rayleigh ambient.

VEHICLE NOISE TEST 09/21/79 (M/D/Y)

TEST SETUP DATA: 5 11:46:55 (H:M:S)

VEHICLE DESCRIPTION
N/A AS-AI TEST (CLEAR)

ANTENNA DESCRIPTION
DIPOLE 300MHZ

TEST CODE: 14 VEHICLES IN THE TEST: 0

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 0 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	160E-01	3.9	51.3dBuV	19.0dBuV	.8dB	29.7dBuV	-90.2dBm
2	.0005	960E-01	7.8					
3	.0010	116E+00	7.8					
4	.0100	127E+01	5.8					
5	.0200	293E+01	4.9					
6	.0500	490E+01	3.9					
7	.1000	743E+01	2.9					
8	.2000	125E+02	.9					
9	.3000	141E+02	-.1					
10	.4000	143E+02	-1.1					

RMS level compares to 3.46 dB above KTo = 19.30 dBuV across 50ohms

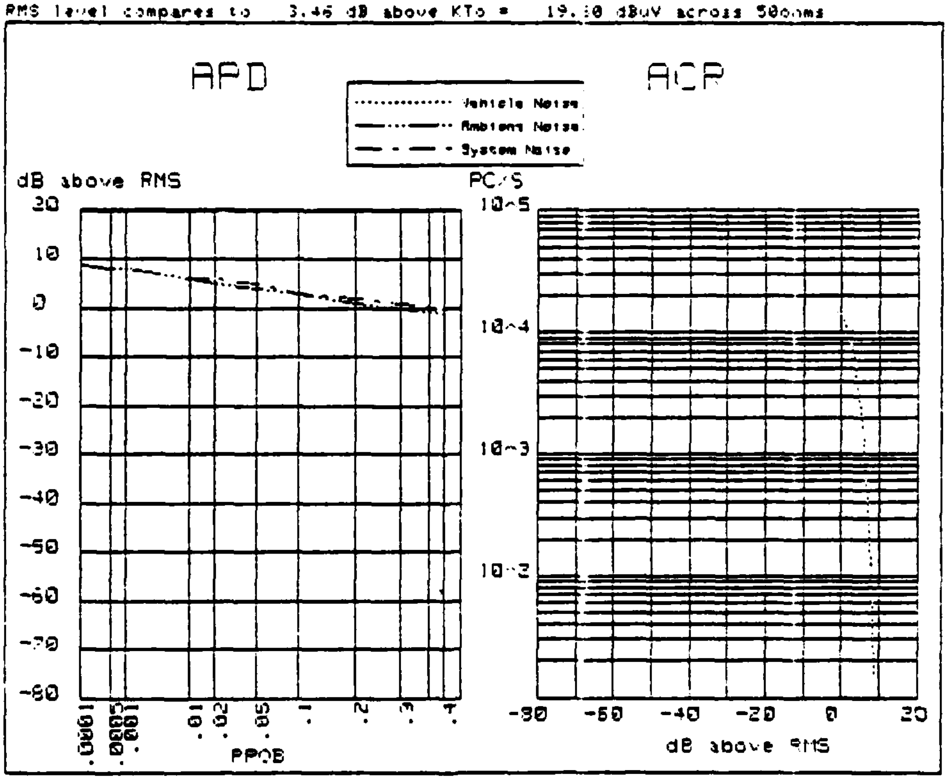


Figure 3-42. APD/ACR data plots for test 5 and test code 14 with Rayleigh ambient.

VEHICLE NOISE TEST 08/21 79 (M/D/Y)

TEST SETUP DATA: 7 12:13:03 (H:M:S)

VEHICLE DESCRIPTION
N/A AS-AI TEST (CLEAR)

ANTENNA DESCRIPTION
DIPOLE 900MHZ

TEST CODE: 14 VEHICLES IN THE TEST: 0

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 0 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	430E+00	8.2	56.1dBuV	23.5dBuV	.8dB	34.6dBuV	-85.7dBm
2	.0005	459E+00	8.2					
3	.0010	214E+01	7.2					
4	.0100	177E+02	5.3					
5	.0200	179E+02	5.3					
6	.0500	360E+02	4.3					
7	.1000	880E+02	2.3					
8	.2000	114E+03	1.3					
9	.3000	134E+03	.3					
10	.4000	146E+03	-.7					

RMS level compares to 3.24 dB above KTo = 24.34 dBuV across 50ohms

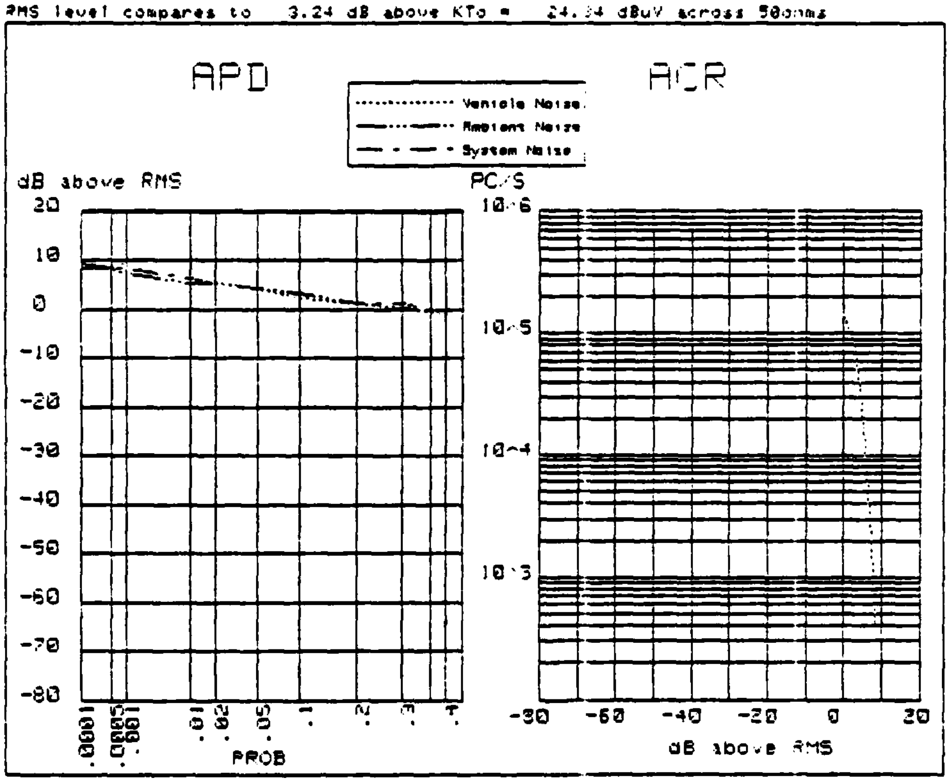


Figure 3-43. APD/ACR data plots for test 7 and test code 14 with Rayleigh ambient.

VEHICLE NOISE TEST
2

08 22/79 (M D Y)
23:32:55 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS. (6 OR 8 CYL)	BICON TYPE 407

TEST CODE: 25 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
23.5 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	200E-02	23.3	43.1dBuV	26.3dBuV	1.8dB	51.9dBuV	-82.0dBm
2	.0005	150E-01	19.4					
3	.0010	140E-01	19.4					
4	.0100	290E+00	4.5					
5	.0200	609E+00	3.5					
6	.0500	121E+01	2.6					
7	.1000	179E+01	1.6					
8	.2000	336E+01	-.4					
9	.3000	394E+01	-1.4					
10	.4000	399E+01	-1.4					

RMS level compares to 14.93 dB above KTb = 23.35 dBuV across 50ohms

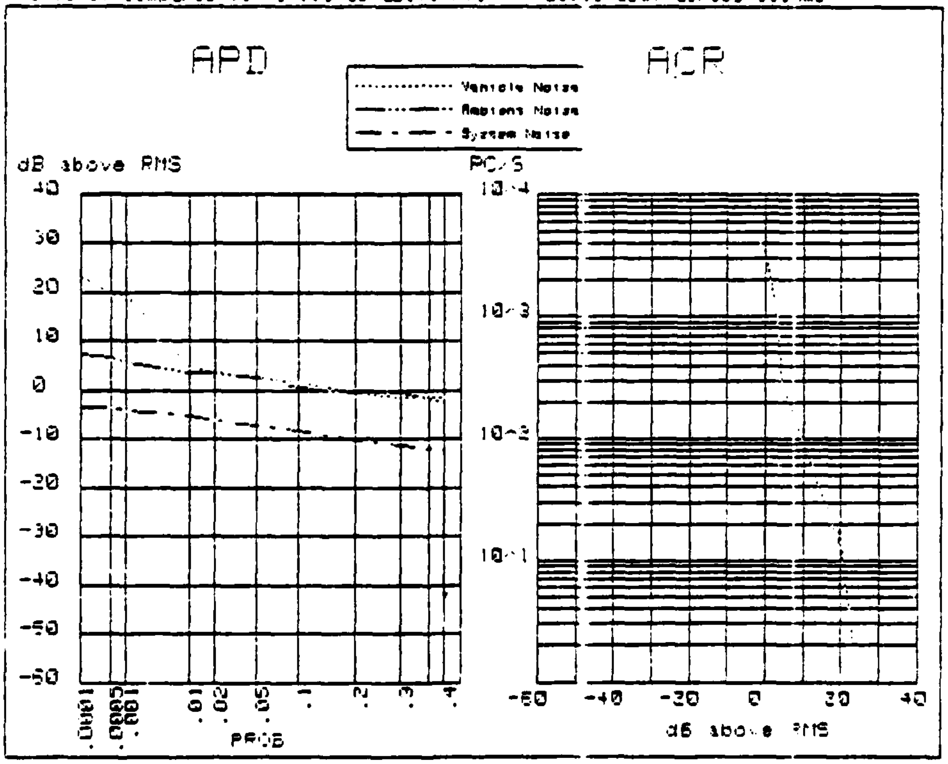


Figure 3-44. APD/ACR data plots for test 2 and test code 25 with Rayleigh ambient.

VEHICLE NOISE TEST
6

08/23/79 (M/D/Y)
00:26:21 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS. (6 OR 8 CYL)	LOG APN-107

TEST CODE: 25 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise F.
1	.0001	400E-02	26.3	52.3dBuV	28.3dBuV	1.7dB	50.1dBuV	-79.5dBm
2	.0005	240E-01	20.3					
3	.0010	400E-01	18.9					
4	.0100	892E+00	4.0					
5	.0200	206E+01	3.0					
6	.0500	379E+01	2.0					
7	.1000	104E+02	1.0					
8	.2000	110E+02	.1					
9	.3000	141E+02	-.9					
10	.4000	128E+02	-.9					

RMS level compares to 12.74 dB above KTo = 30.74 dBuV across 50ohms

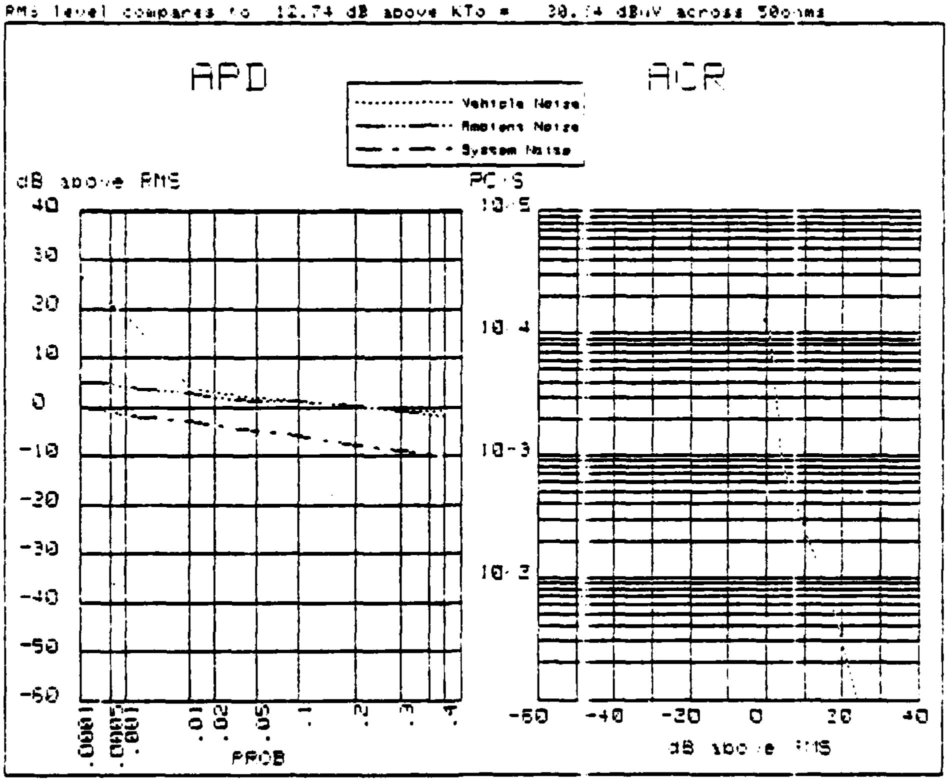


Figure 3-45. APD/ACR data plots for test 6 and test code 25 with Rayleigh ambient.

VEHICLE NOISE TEST
10

TEST SETUP DATA:

08/22/79 (M/D/Y)
01:27:04 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
LOG APN-107

TEST CODE: 25 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise F.
1	.0001	600E-02	31.6	53.8dBuV	22.4dBuV	7.3dB	59.4dBuV	-80.3dBm
2	.0005	230E-01	26.7					
3	.0010	460E-01	19.7					
4	.0100	832E+00	-1.1					
5	.0200	195E+01	-2.0					
6	.0500	356E+01	-3.0					
7	.1000	836E+01	-5.0					
8	.2000	111E+02	-6.0					
9	.3000	131E+02	-7.0					
10	.4000	144E+02	-8.0					

RMS level compares to 10.92 dB above KTo = 29.67 dBuV across 50ohms

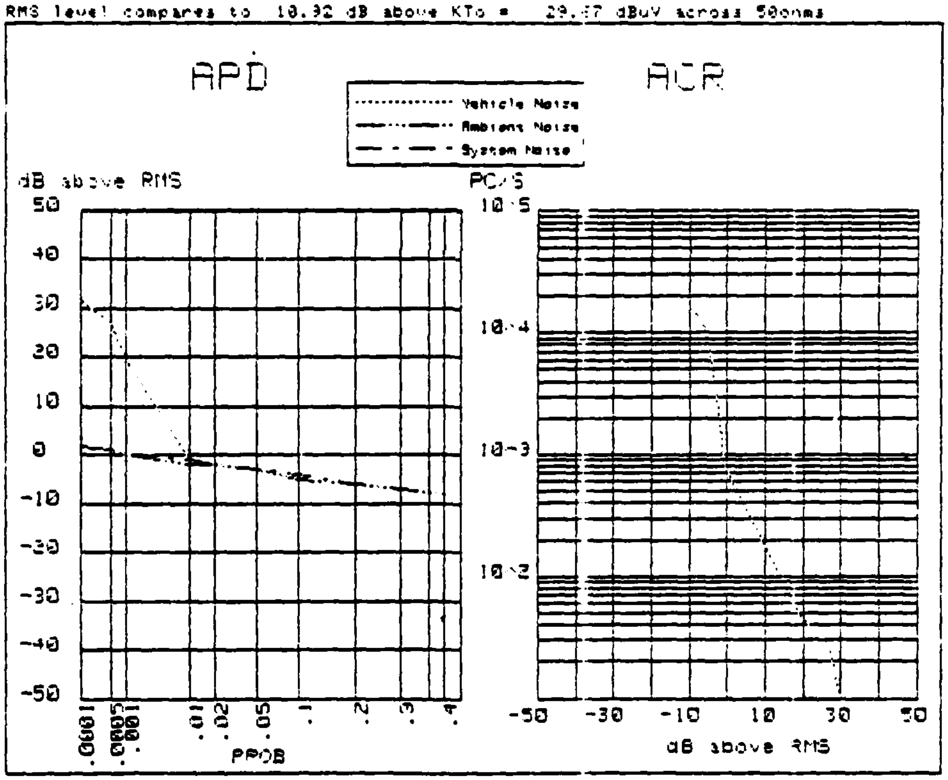


Figure 3-46. APD/ACR data plots for test 10 and test code 25 with Rayleigh ambient.

TEST SETUP DATA: VEHICLE NOISE TEST 14 08/23/79 (M/D/Y) 02:10:39 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
LOG APN-107

TEST CODE: 25 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	480E-01	22.4	56.8dBuV	26.9dBuV	4.1dB	54.5dBuV	-79.0dBm
2	.0005	176E+00	7.5					
3	.0010	171E+01	3.6					
4	.0100	161E+02	1.6					
5	.0200	162E+02	1.6					
6	.0500	346E+02	.6					
7	.1000	603E+02	-.4					
9	.2000	114E+03	-2.4					
9	.3000	134E+03	-3.4					
10	.4000	144E+03	-4.4					

RMS level compares to 9.22 dB above KTo = 31.01 dBuV across 50ohms

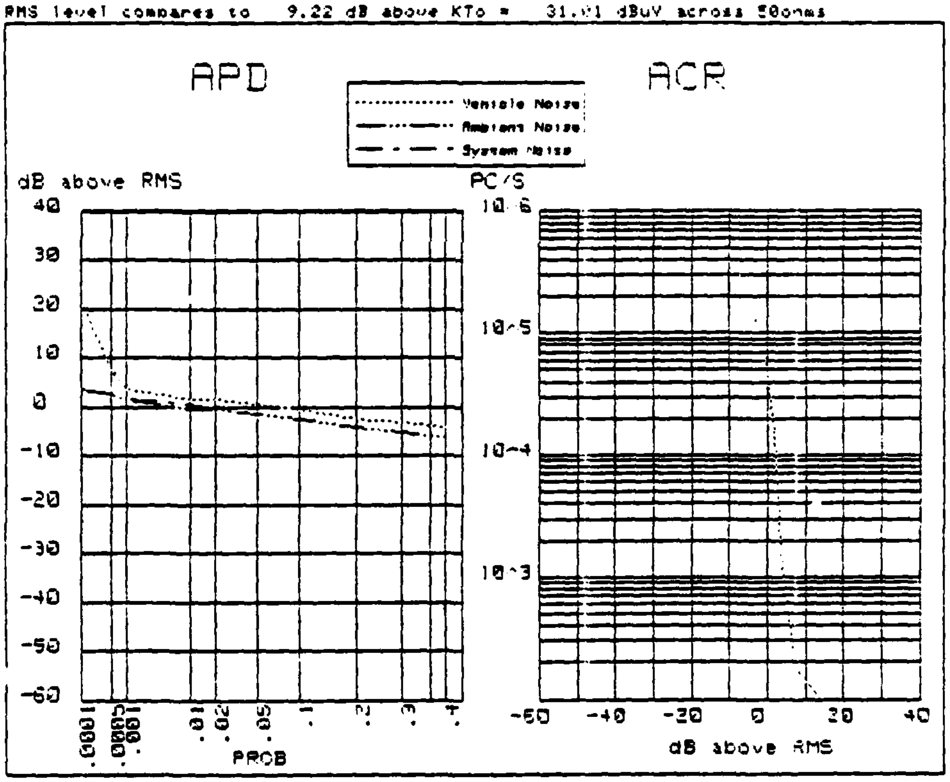


Figure 3-47. APD/ACR data plots for test 14 and test code 25 with Rayleigh ambient.

VEHICLE NOISE TEST 08/22/79 (M D Y)

TEST SETUP DATA: 2 15:38:46 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON TYPE 407

TEST CODE: 15 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
23.5 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	400E-02	24.3	47.7dBuV	25.6dBuV	1.5dB	52.13uV	-30.0dBm
2	.0005	800E-02	22.4					
3	.0010	270E-01	16.4					
4	.0100	322E+00	3.5					
5	.0200	658E+00	2.6					
6	.0500	168E+01	1.6					
7	.1000	223E+01	.6					
8	.2000	324E+01	-.4					
9	.3000	329E+01	-.4					
10	.4000	411E+01	-1.4					

RMS level compares to 17.34 dB above KTo = 30.93 dBuV across 50ohms

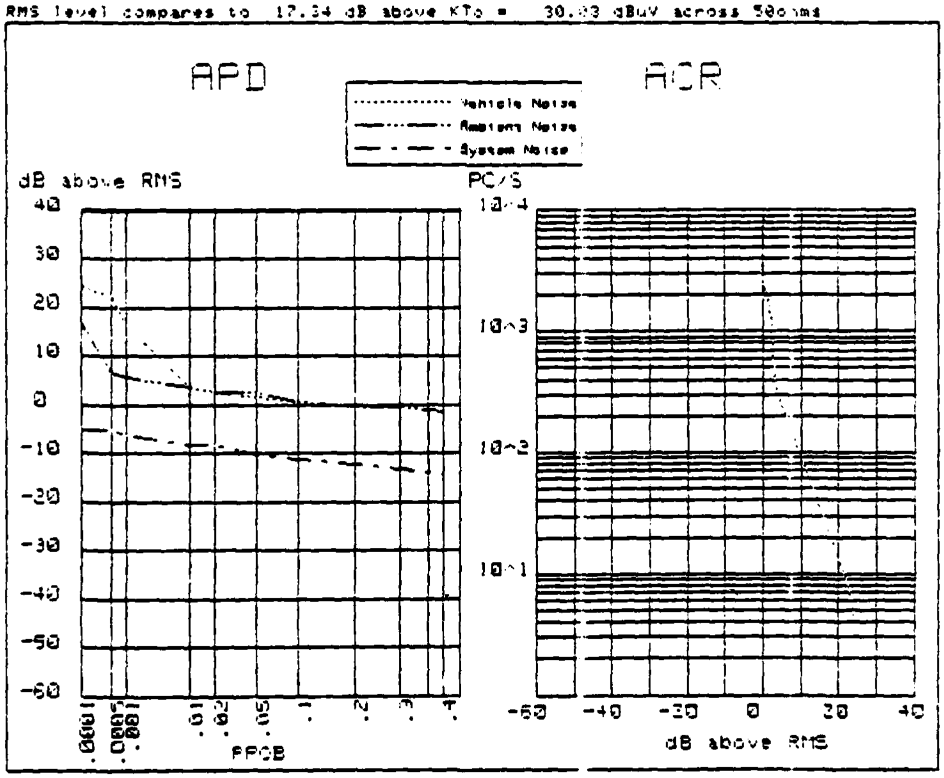


Figure 3-48. APD/ACR data plots for test 2 and test code 15 with Rayleigh ambient.

VEHICLE NOISE TEST 08/22/79 (M/D/Y)

TEST SETUP DATA: 7 20:57:52 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
LOG APN-107

TEST CODE: 15 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	100E-01	27.7	52.5dBuV	27.5dBuV	3.1dB	43.7dBuV	-79.4dBm
2	.0005	200E-01	23.8					
3	.0010	240E-01	17.8					
4	.0100	600E+00	3.0					
5	.0200	124E+01	2.0					
6	.0500	277E+01	1.0					
7	.1000	534E+01	.0					
8	.2000	792E+01	-1.0					
9	.3000	103E+02	-2.0					
10	.4000	112E+02	-2.9					

RMS level compares to 13.10 dB above KTo = 30.58 dBuV across 50ohms

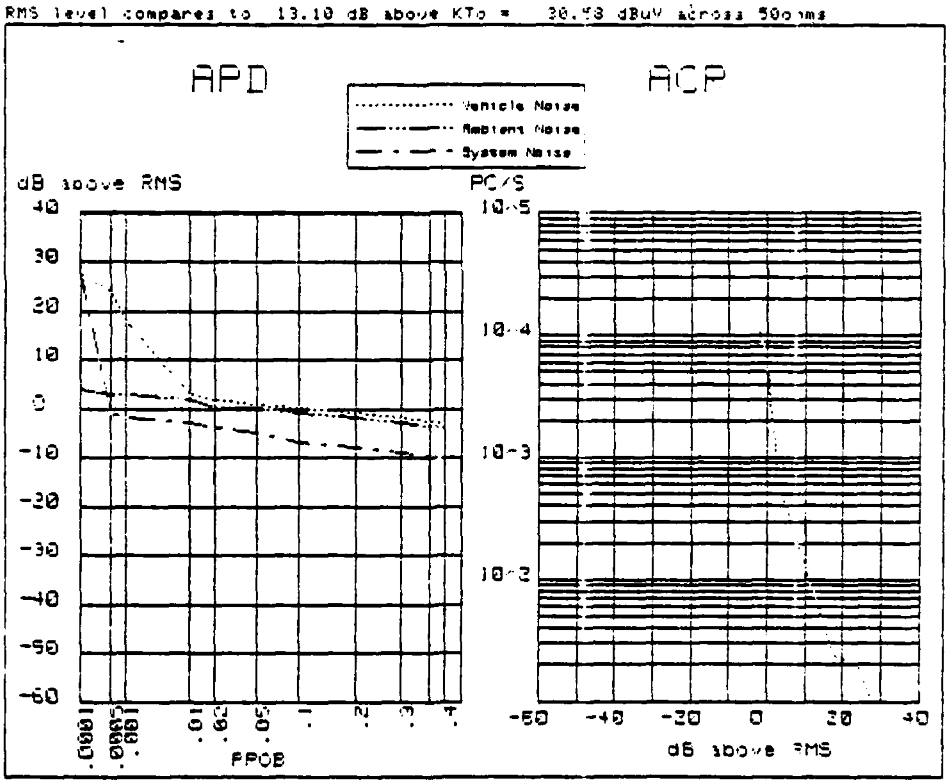


Figure 3-49. APD/ACR data plots for test 7 and test code 15 with Rayleigh ambient.

VEHICLE NOISE TEST 08/22/79 (M/D/Y)

TEST SETUP DATA: 11 21:48:03 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
LOG APN-107

TEST CODE: 15 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	400E-02	33.4	53.9dBuV	22.6dBuV	7.3dB	56.4dBuV	-80.1dBm
2	.0005	260E-01	25.5					
3	.0010	460E-01	21.5					
4	.0100	966E+00	-1.3					
5	.0200	234E+01	-2.3					
6	.0500	416E+01	-3.2					
7	.1000	664E+01	-4.2					
8	.2000	116E+02	-6.2					
9	.3000	135E+02	-7.2					
10	.4000	144E+02	-8.2					

RMS level compares to 11.03 dB above KTo = 29.89 dBuV across 50ohms

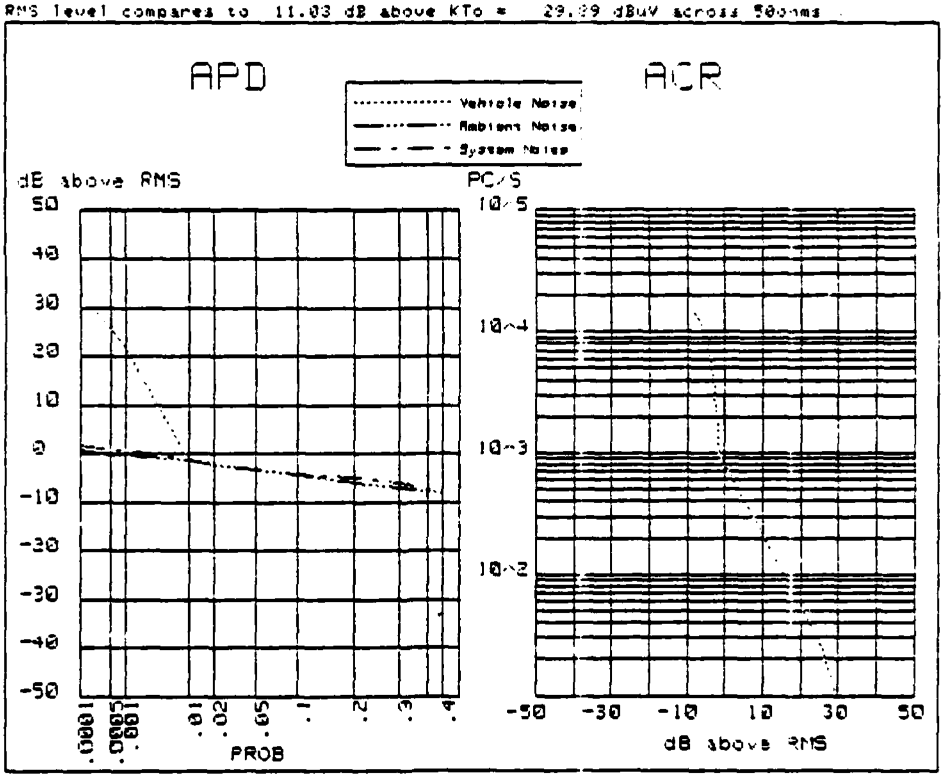


Figure 3-50. APD/ACR data plots for test 11 and test code 15 with Rayleigh ambient.

VEHICLE NOISE TEST
15

08/22/79 (M/D/Y)
22:36:23 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS. (6 OR 8 CYL)	LOG APN-107

TEST CODE: 15 VEHICLES IN THE TEST: 9

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	420E-01	22.9	56.7dBuV	26.5dBuV	2.0dB	69.9dBuV	-81.5dBm
2	.0005	380E+00	7.0					
3	.0010	128E+01	6.0					
4	.0100	141E+02	4.1					
5	.0200	311E+02	3.1					
6	.0500	308E+02	3.1					
7	.1000	823E+02	1.1					
8	.2000	109E+03	.1					
9	.3000	130E+03	-.9					
10	.4000	142E+03	-1.9					

RMS level compares to 6.73 dB above KTo = 28.72 dBuV across 50ohms

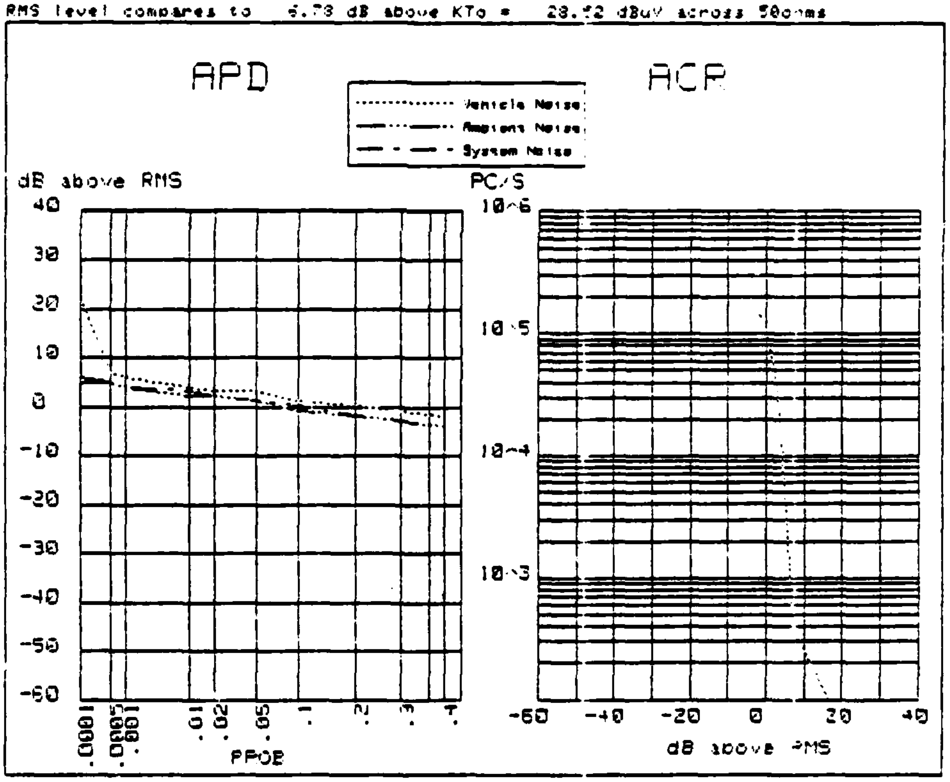


Figure 3-51. APD/ACR data plots for test 15 and test code 15 with Rayleigh ambient.

VEHICLE NOISE TEST 08/22/79 (M/D/Y)

TEST SETUP DATA: 3 00:14:36 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON TYPE 407

TEST CODE: 17 VEHICLES IN THE TEST: 1 2 3 4 9 11

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
23.5 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	200E-02	18.8	49.2dBuV	33.4dBuV	2.1dB	53.8dBuV	-74.5dBm
2	.0005	100E-01	17.8					
3	.0010	170E-01	16.9					
4	.0100	147E+00	11.9					
5	.0200	301E+00	8.9					
6	.0500	569E+00	3.0					
7	.1000	136E+01	.0					
8	.2000	201E+01	-1.0					
9	.3000	275E+01	-2.0					
10	.4000	301E+01	-2.9					

RMS level compares to 22.37 dB above KTo = 35.53 dBuV across 50ohms

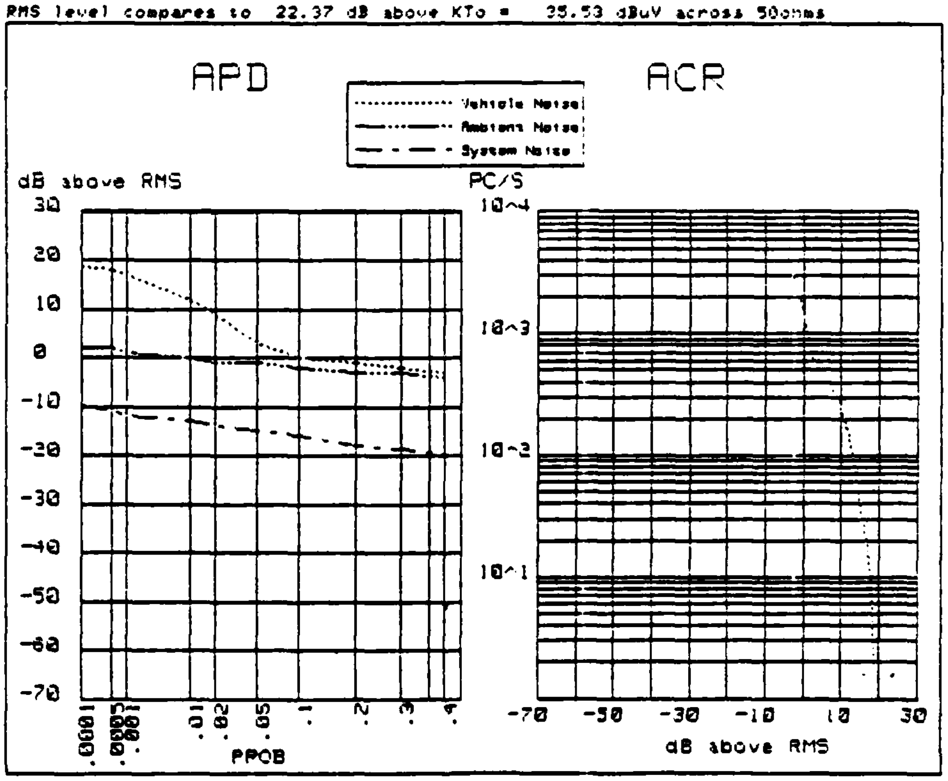


Figure 3-52. APD/ACR data plots for test 3 and test code 17 with Rayleigh ambient.

VEHICLE NOISE TEST

TEST SETUP DATA: 7

08/22/79 (M/D/Y)
00:46:13 (H:M:S)

VEHICLE DESCRIPTION: CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION: BICON TYPE 407

TEST CODE: 17 VEHICLES IN THE TEST: 1 2 3 4 9 11

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	400E-02	26.4	52.8dBuV	39.4dBuV	5.4dB	69.2dBuV	-65.2dBm
2	.0005	440E-01	22.5					
3	.0010	720E-01	21.5					
4	.0100	414E+00	7.6					
5	.0200	674E+00	3.6					
6	.0500	179E+01	-3.3					
7	.1000	830E+01	-4.3					
8	.2000	105E+02	-6.3					
9	.3000	162E+02	-6.3					
10	.4000	147E+02	-7.2					

RMS level compares to 27.03 dB above KTo = 44.78 dBuV across 50ohms

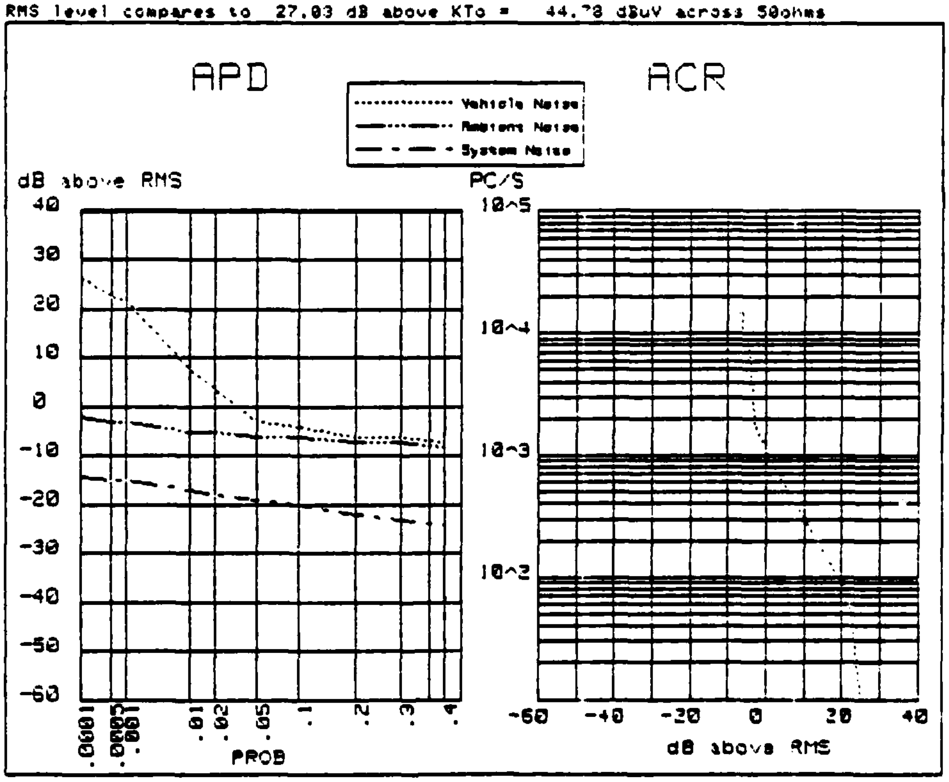


Figure 3-53. APD/ACR data plots for test 7 and test code 17 with Rayleigh ambient.

VEHICLE NOISE TEST 08/22/79 (M/D/Y)

TEST SETUP DATA: 11 01:34:55 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
DIPOLE AC-105 KIT

TEST CODE: 17 VEHICLES IN THE TEST: 1 2 3 4 9 11

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	100E-01	29.1	53.9dBuV	24.5dBuV	5.7dB	57.0dBuV	-79.8dBm
2	.0005	500E-01	23.1					
3	.0010	620E-01	22.1					
4	.0100	432E+00	9.3					
5	.0200	882E+00	1.4					
6	.0500	281E+01	-1.6					
7	.1000	682E+01	-3.6					
8	.2000	947E+01	-4.6					
9	.3000	133E+02	-6.6					
10	.4000	142E+02	-7.6					

RMS level compares to 11.37 dB above KTo = 38.24 dBuV across 50ohms

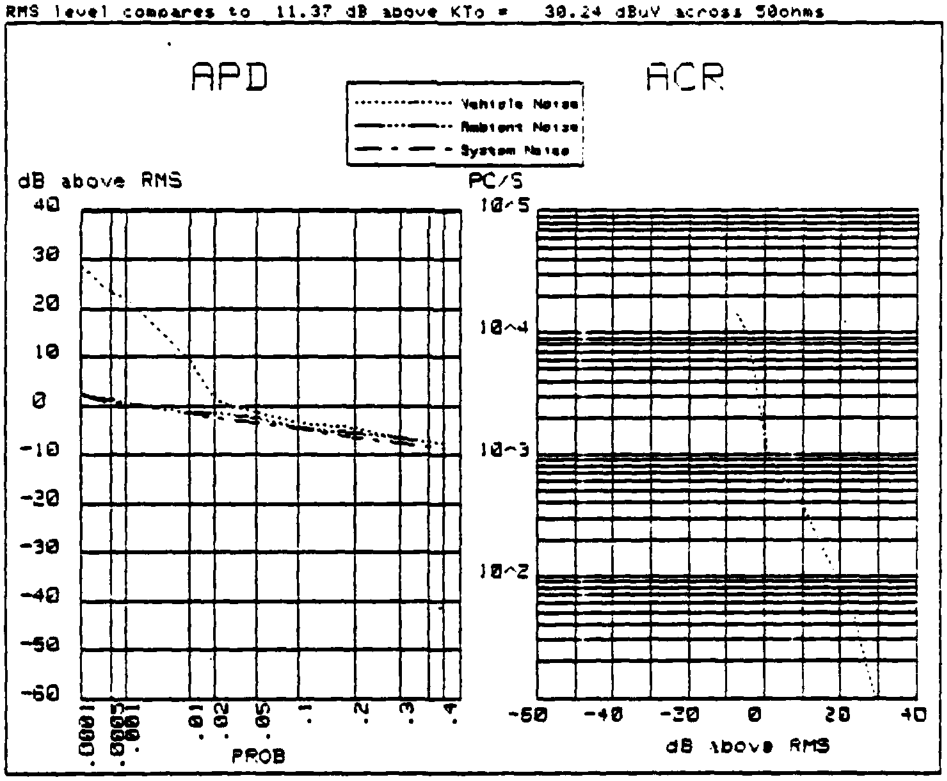


Figure 3-54. APD/ACR data plots for test 11 and test code 17 with Rayleigh ambient.

VEHICLE NOISE TEST 08/22/79 (M/D/Y)

TEST SETUP DATA: 15 02:37:27 (H:M:S)

VEHICLE DESCRIPTION: CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION: DIPOLE AC-105 KIT

TEST CODE: 17 VEHICLES IN THE TEST: 1 2 3 4 9 11

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	440E-01	31.3	56.7dBuV	25.2dBuV	5.3dB	69.5dBuV	-79.0dBm
2	.0005	188E+00	20.4					
3	.0010	324E+00	16.5					
4	.0100	956E+01	.6					
5	.0200	203E+02	-.4					
6	.0500	381E+02	-1.4					
7	.1000	619E+02	-2.4					
8	.2000	115E+03	-4.3					
9	.3000	134E+03	-5.3					
10	.4000	146E+03	-6.3					

RMS level compares to 9.24 dB above kTo = 30.98 dBuV across 50ohms

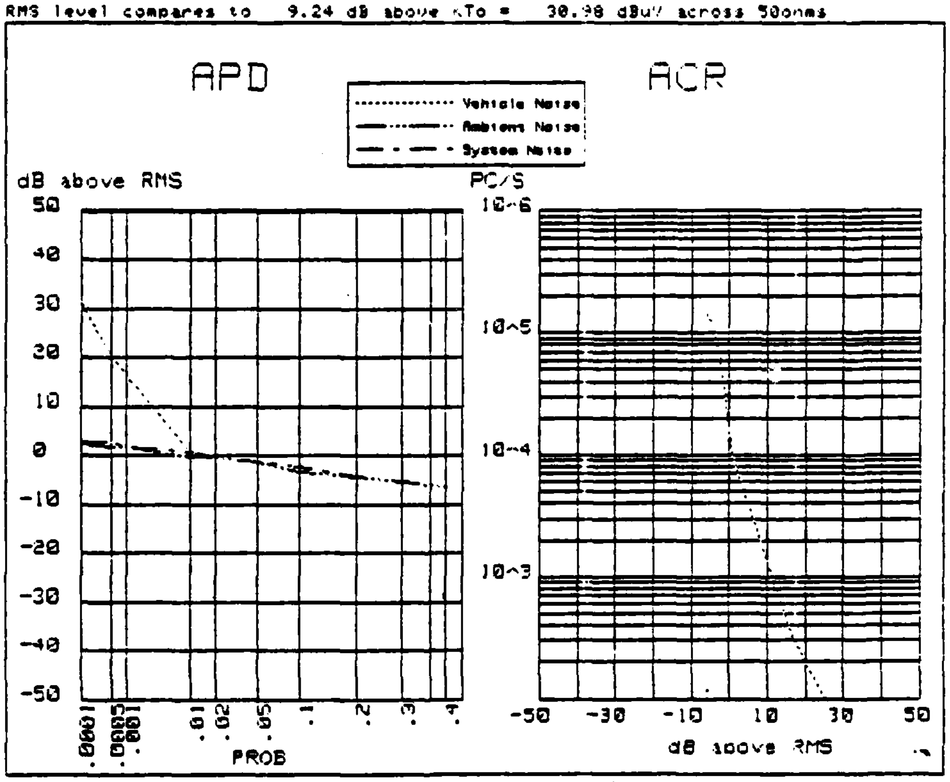


Figure 3-55. APD/ACR data plots for test 15 and test code 17 with Rayleigh ambient.

VEHICLE NOISE TEST
2

08/22/79 (M D Y)
07:01:13 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION
CIVILIAN PASS. (6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON

TEST CODE: 21 VEHICLES IN THE TEST: 1 8 1..

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
23.5 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise F.
1	.0001	100E-02	22.1	48.2dBuV	32.0dBuV	1.2dB	50.7dBuV	-76.9dBm
2	.0005	200E-01	18.3					
3	.0010	260E-01	18.3					
4	.0100	141E+00	9.4					
5	.0200	323E+00	3.4					
6	.0500	875E+00	2.4					
7	.1000	187E+01	1.4					
8	.2000	249E+01	.5					
9	.3000	312E+01	-.5					
10	.4000	312E+01	-1.5					

RMS level compares to 19.95 dB above KTo = 33..2 dBuV across 50ohms

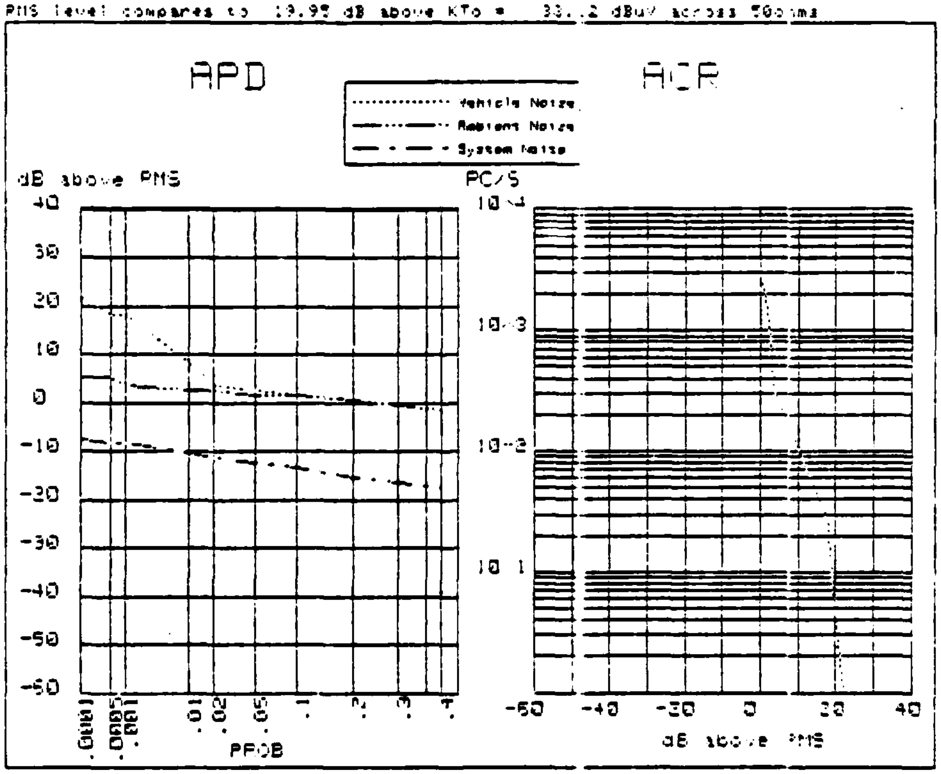


Figure 3-56. APD/ACR data plots for test 2 and test code 21 with Rayleigh ambient.

VEHICLE NOISE TEST 6

08 22 79 (M D Y)
09:08:03 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION		ANTENNA DESCRIPTION
CIVILIAN	PASS.(6 OR 8 CYL)	BICON

TEST CODE: 21   VEHICLES IN THE TEST: 1 S 1.

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	160E-01	27.6	53.1dBuV	34.7dBuV	9.9dB	71.2dBuV	-65.5dBm
2	.0005	420E-01	24.7					
3	.0010	700E-01	22.7					
4	.0100	414E+00	7.3					
5	.0200	630E+00	-1.1					
6	.0500	226E+01	-9.0					
7	.1000	129E+02	-10.0					
8	.2000	129E+02	-12.0					
9	.3000	144E+02	-12.0					
10	.4000	126E+02	-12.0					

RMS level compares to 26.47 dB above KTo = 44.54 dBuV across 50ohms

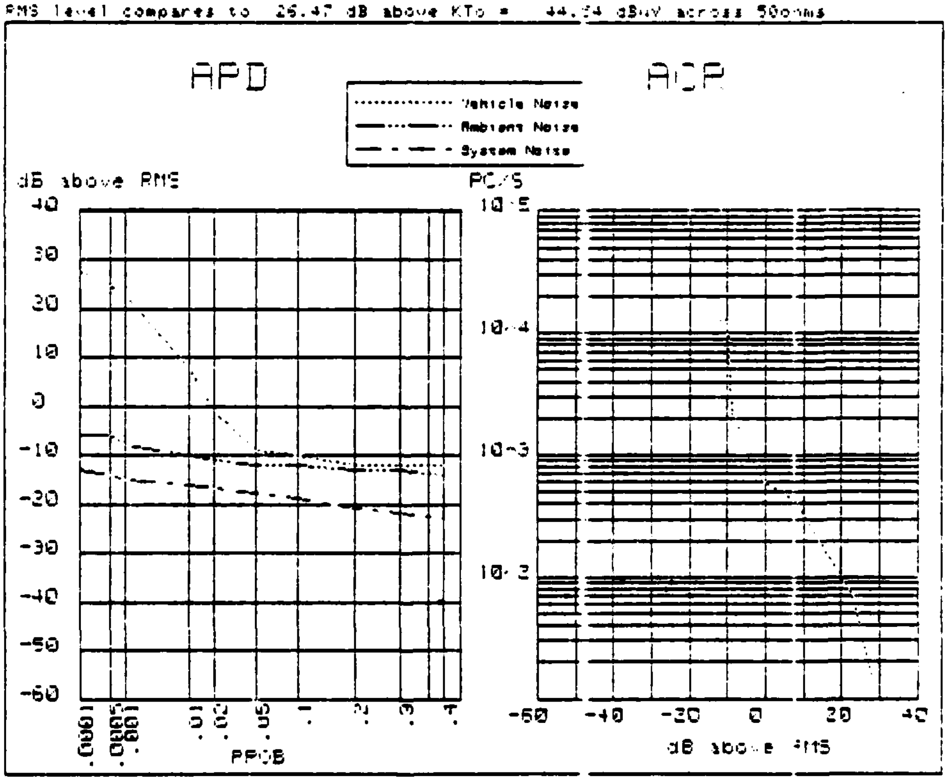


Figure 3-57. APD/ACR data plots for test 6 and test code 21 with Rayleigh ambient.

VEHICLE NOISE TEST
11

08/22/79 (M/D/Y)
11:29:09 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION
CIVILIAN PASS. (6 OR 8 CYL)

ANTENNA DESCRIPTION
DIPOLE 300MHZ

TEST CODE: 21 VEHICLES IN THE TEST: 1 8 11

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Va g	Vd	Vp	Noise F.
1	.0001	120E-01	25.8	51.4dBuV	20.5dBuV	6.1dB	59.13dBuV	-83.4dBm
2	.0005	300E-01	26.8					
3	.0010	900E-01	23.8					
4	.0100	328E+00	3.0					
5	.0200	130E+01	-.9					
6	.0500	326E+01	-1.9					
7	.1000	781E+01	-3.9					
8	.2000	104E+02	-4.9					
9	.3000	127E+02	-5.9					
10	.4000	140E+02	-6.9					

RMS level compares to 10.17 dB above KTo = 26.79 dBuV across 50ohms

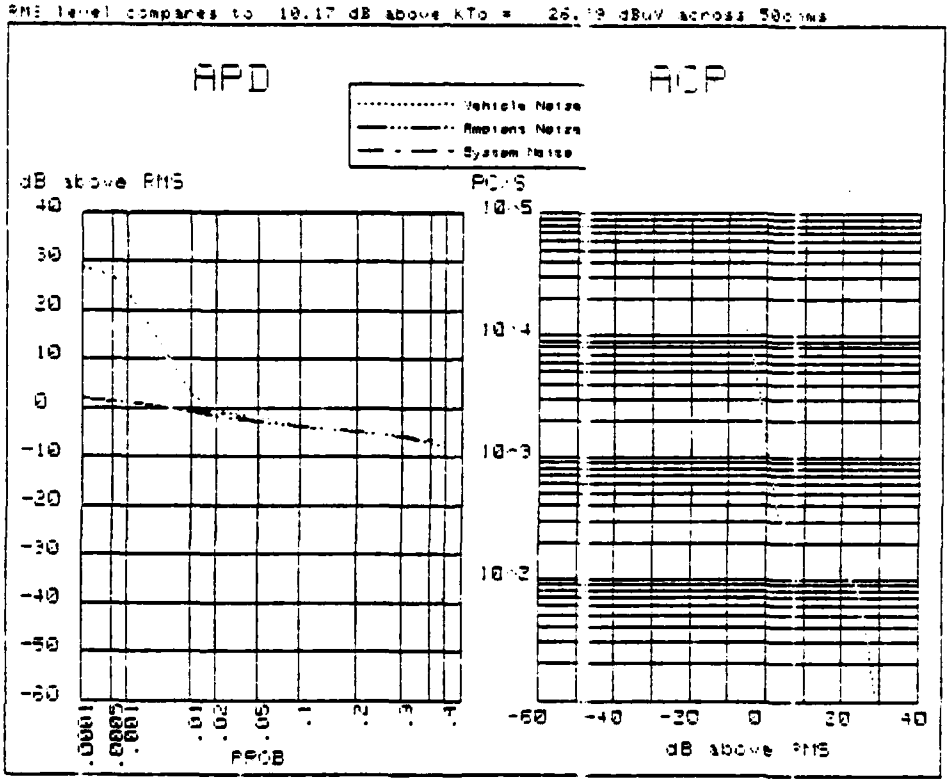


Figure 3-58. APD/ACR data plots for test 11 and test code 21 with Rayleigh ambient.

TEST SETUP DATA: VEHICLE NOISE TEST 16 — 08 22 79 (M.D.Y) 12:35:41 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
DIPOLE 900MHZ

TEST CODE: 21 VEHICLES IN THE TEST: 1 8 1?

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	520E-01	25.4	56.0dBuV	23.3 dBuV	1.2dB	51.1dBuV	-35.0dBm
2	.0005	216E+00	14.5					
3	.0010	462E+00	8.6					
4	.0100	823E+01	5.6					
5	.0200	197E+02	4.6					
6	.0500	364E+02	3.7					
7	.1000	627E+02	2.7					
8	.2000	116E+03	.7					
9	.3000	136E+03	-.3					
10	.4000	147E+03	-1.3					

RMS level compares to 3.95 dB above KTo = 24.46 dBuV across 50ohms

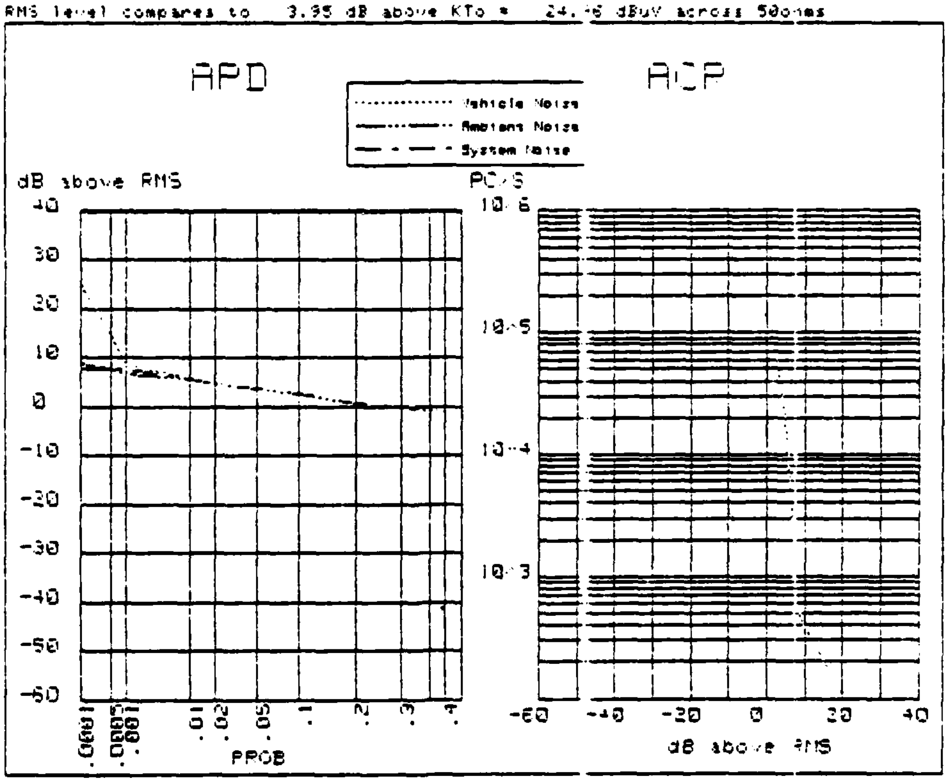


Figure 3-59. APD/ACR data plots for test 16 and test code 21 with Rayleigh ambient.

THE SELECTED VEHICLES FOR TEST CODE 16 ARE NUMBER(S):
1 2 3 4 5 6 7 8 9 10 11 12

TEST SETUP DATA: VEHICLE NOISE TEST 1 — 08/21/79 (M/D/Y) 18:48:45 (H:M:S)

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON TYPE 407

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
23.5 MHz	10 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	300E-02	19.7	58.4dBuV	35.6dBuV	3.1dB	62.3dBuV	-71.3dBm
2	.0005	130E-01	17.7					
3	.0010	320E-01	16.7					
4	.0100	173E+00	12.7					
5	.0200	355E+00	9.8					
6	.0500	629E+00	5.8					
7	.1000	936E+00	.9					
8	.2000	189E+01	-3.1					
9	.3000	269E+01	-4.1					
10	.4000	312E+01	-5.1					

RMS level compares to 23.26 dB above KTo = 38.65 dBuV across 50ohms

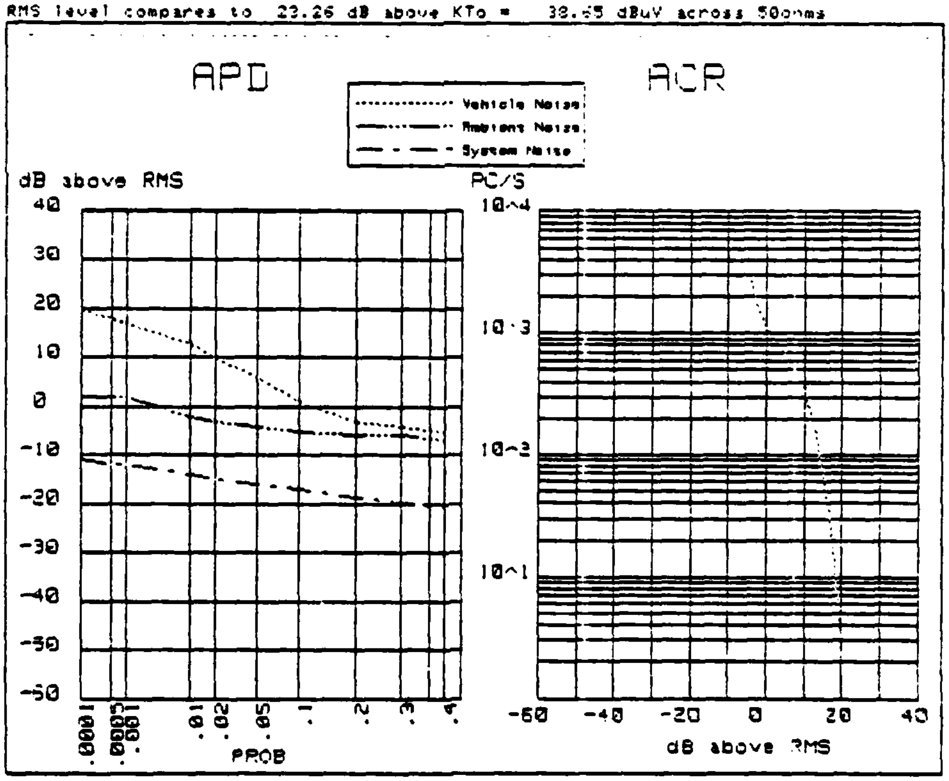


Figure 3-60. APD/ACR data plots for test 1 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST
5

08/21/79 (M/D/Y)
19:25:01 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
BICON TYPE 407

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
75 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	100E-01	27.3	52.6dBuV	37.7dBuV	9.1dB	72.0dBuV	-63.1dBm
2	.0005	400E-01	23.3					
3	.0010	820E-01	21.3					
4	.0100	498E+00	12.4					
5	.0200	798E+00	7.5					
6	.0500	157E+01	.5					
7	.1000	310E+01	-7.4					
8	.2000	598E+01	-12.3					
9	.3000	906E+01	-14.3					
10	.4000	101E+02	-15.3					

RMS level compares to 29.32 dB above KTo = 46.39 dBuV across 50ohms

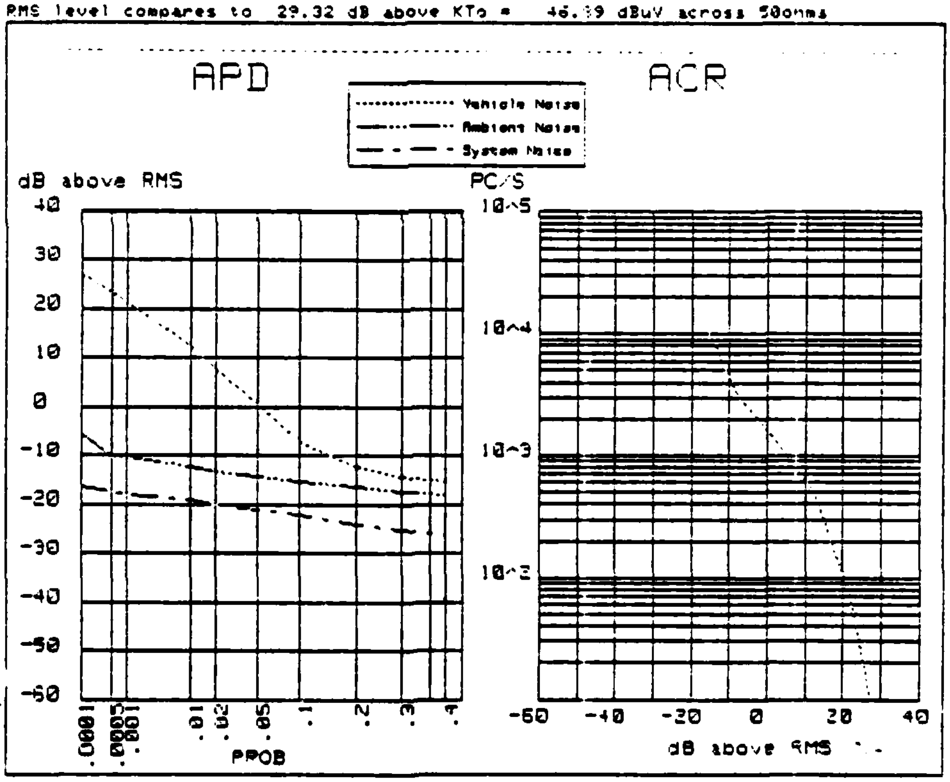


Figure 3-61. APD/ACR data plots for test 5 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST   08/21/79 (M/D/Y)

TEST SETUP DATA: 9   21:00:54 (H:M:S)

VEHICLE DESCRIPTION: CIVILIAN   PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION: DIPOLE AC-105 KIT

TEST CODE: 16   VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
300 MHz	30 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	130E-01	29.1	52.1dBuV	24.5dBuV	7.7dB	57.8dBuV	-77.8dBm
2	.0005	400E-01	25.2					
3	.0010	360E-01	22.2					
4	.0100	466E+00	12.3					
5	.0200	830E+00	7.4					
6	.0500	192E+01	-1.6					
7	.1000	395E+01	-5.5					
8	.2000	906E+01	-8.5					
9	.3000	111E+02	-9.5					
10	.4000	133E+02	-11.5					

RMS level compares to 15.09 dB above KTo = 32.16 dBuV across 50ohms

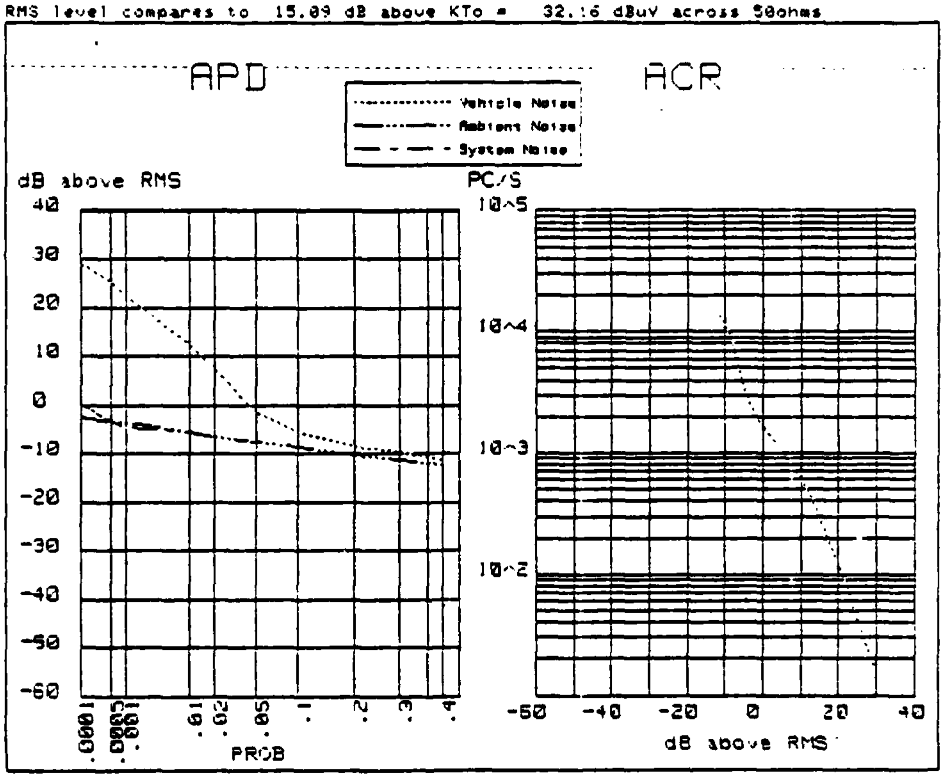


Figure 3-62. APD/ACR data plots for test 9 and test code 16 with Rayleigh ambient.

VEHICLE NOISE TEST
13

08/21/79 (M/D/Y)
22:20:53 (H:M:S)

TEST SETUP DATA:

VEHICLE DESCRIPTION
CIVILIAN PASS.(6 OR 8 CYL)

ANTENNA DESCRIPTION
DIPOLE AC-105 KIT

TEST CODE: 16 VEHICLES IN THE TEST: 1 2 3 4 5 6 7 8 9 10 11 12

REC. FREQ.	SPEC. ANAL. BW	ENGINE SPEED	ANTENNA POSITION
900 MHz	300 kHz	1500 RPM	0 deg. 3 m.

MEASURED APD VALUES:

Point	Prob.	PC/S	dBrms	Cal. RMS	Vavg	Vd	Vp	Noise P.
1	.0001	560E-01	34.0	56.4dBuV	24.9dBuV	2.4dB	64.2dBuV	-82.7dBm
2	.0005	258E+00	24.1					
3	.0010	448E+00	19.1					
4	.0100	644E+01	5.3					
5	.0200	105E+02	4.3					
6	.0500	374E+02	2.3					
7	.1000	601E+02	1.3					
8	.2000	110E+03	-.7					
9	.3000	130E+03	-1.7					
10	.4000	143E+03	-2.7					

RMS level compares to 5.39 dB above KTo = 27.31 dBuV across 50ohms

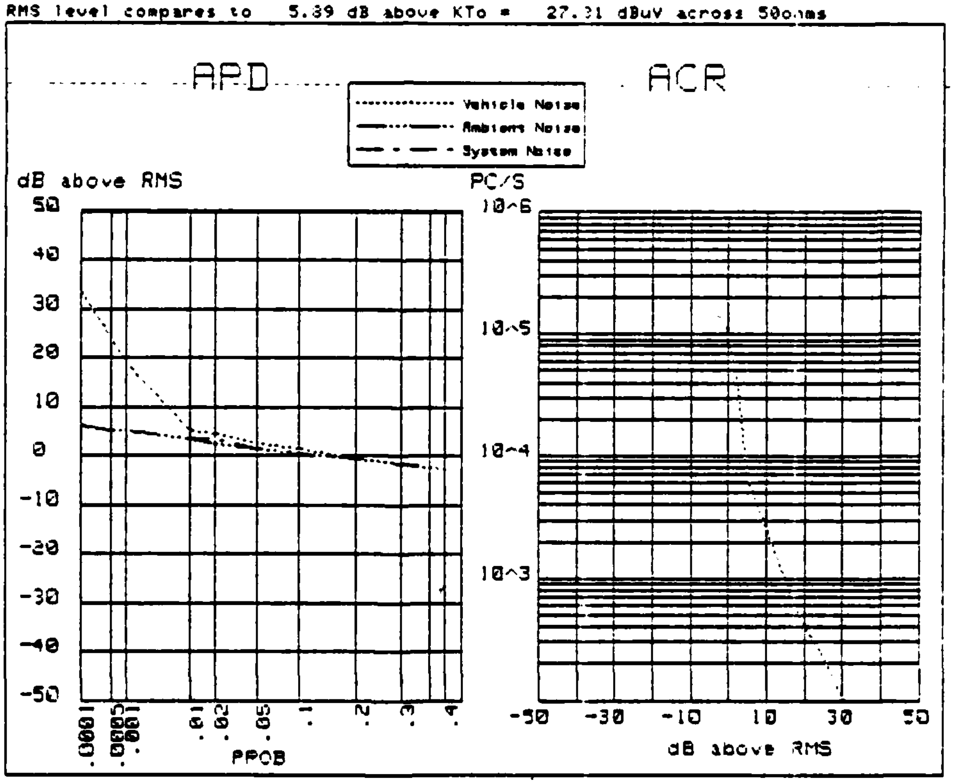


Figure 3-63. APD/ACR data plots for test 13 and test code 16 with Rayleigh ambient.

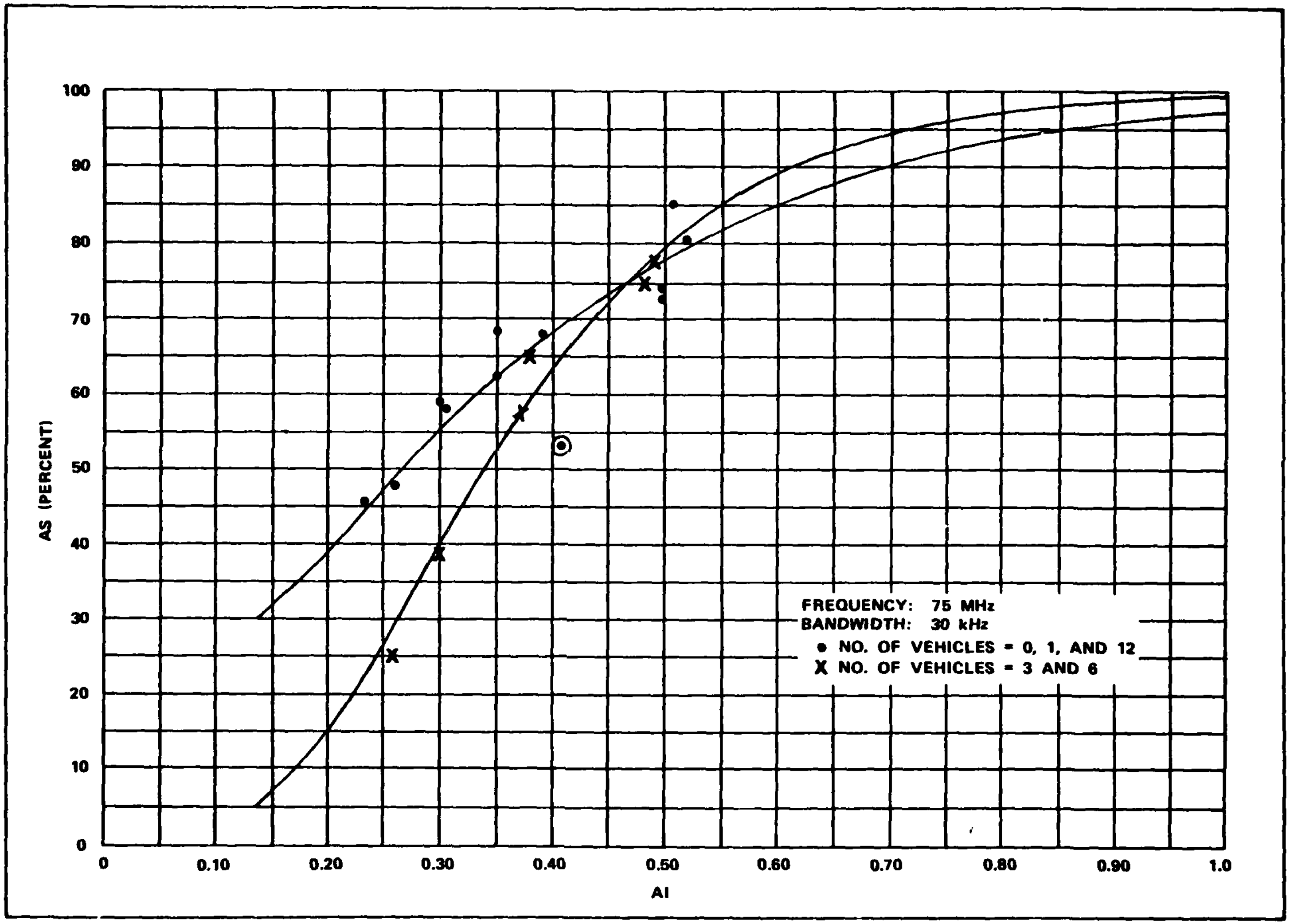


Figure 3-64. AS versus AI for FM link.

3.4 COMPUTER PRINTOUTS OF APD STRAIGHT-LINE APPROXIMATIONS FOR SINGLE AND MULTIPLE VEHICLES

This paragraph presents the computer printouts of the results of APD straight-line fitting for the vehicular and ambient regions. Test codes 1 through 12, 15, and 29 are single-vehicles tests. Test codes 16 through 24 are multiple-vehicle tests. In test code 30, no vehicles were running (ambient interference only). Line fitting was done on a PDP 11/45 computer with the procedures described in 3.1.2 and 3.1.3, above.

DESCRIPTION OF COMPUTER PRINTOUT HEADINGS FOR APD STRAIGHT-LINE APPROXIMATIONS

FREQ = Test Measurement Frequency

1-23 MHz

2-75 MHz

3-300 MHz

4-900 MHz

BW = Test Measurement Bandwidth

1-3 kHz

2-10 kHz

3-30 kHz

4-100 kHz

5-300 kHz

First of a line pair: Results of piecewise linear regression on the raw data (see section 3.1.2).

Second of a line pair: Results after possibly pivoting ambient and/or vehicular lines (see section 3.1.3).

VTRMS = Measured V_{rms} in dB(μV), if on the first line.

VTRMS = Calculated V_{rms} in dB(μV), if on the ADJUSTED line.

MV = m_v parameter of Weibull distribution for vehicular noise component.

KV = $10 \log_{10} k_v$, where k_v is k Weibull distribution parameter for the vehicular noise component.

VVRMS = Calculated vehicular noise component in dB(μV).

MA = m_a parameter of Weibull distribution for ambient noise component.

KA = $10 \log_{10} k_a$ is k Weibull distribution parameter for ambient noise component.

VARMS = Calculated ambient noise component in dB(μV).

INTERSECT: DB PROB = Coordinate point on APD plot where lines for ambient and vehicular noise regions intersect.

Flags:

- * = Measured $V_{rms} > V_a$
- \+ = Calculated V_{rms} > measured by more than 3 and less than 6 dB.
- ++ = Calculated V_{rms} > measured by more than 6 dB.
- \- = Calculated V_{rms} < measured by more than 3 and less than 6 dB.
- R = Ambient line pivoted to a Rayleigh slope.
- m_a = 999.99, K = asterisk string = zero slope to the ambient line.

APD LINE PARAMETERS TEST 1

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	40.01	0.3926	-0.361	23.34	5.0221	-100.836	39.64	43.41	0.0014
ADJUSTED:		39.74	0.3926	-0.361	23.34	5.0221	-100.836	39.64	43.41	0.0014
1	2	46.03	0.9399	-14.503	34.40	8.6186	-178.324	40.97	42.67	0.0276
ADJUSTED:		42.17-	1.1749	-20.027	35.99	8.6186	-178.324	40.97	42.53	0.0437
1	3	41.89	0.4969	-5.331	35.42	3.2964	-69.798	41.86	46.06	0.0168
ADJUSTED:		42.75	0.4969	-5.331	35.42	3.2964	-69.798	41.86	46.06	0.0168
2	1	19.33	0.8875	-4.995	15.34	3.2964	-32.268	19.09	22.64	0.0407
ADJUSTED:		20.62	0.8875	-4.995	15.34	3.2964	-32.268	19.09	22.64	0.0407
2	2	21.16	0.4186	0.980	14.48	2.8527	-29.078	19.97	24.70	0.0162
ADJUSTED:		21.15	0.4670	0.181	14.91	2.8527	-29.078	19.97	24.53	0.0203
2	3	21.37	0.4908	1.196	9.42	2.0194	-21.122	20.90	29.20	0.0011
ADJUSTED:		21.18	0.4908	1.196	9.42 R	2.0000	-20.880	20.88	29.25	0.0010
2	4	30.18 *	0.2032	4.063	24.01	2.8528	-43.931	30.38	36.23	0.0026
ADJUSTED:		31.28	0.2032	4.063	24.01	2.8528	-43.931	30.38	36.23	0.0026
2	5	33.84	0.1404	5.409	35.19	1.6238	-25.990	32.51	42.33	0.0010
ADJUSTED:		34.06	0.1755	4.508	28.85	1.6238	-25.990	32.51	42.12	0.0013
3	2	27.07	0.2369	2.709	27.36	1.7627	-14.846	17.12	23.01	0.0304
ADJUSTED:		27.06	0.2489	2.465	26.58 R	2.0000	-17.211	17.21	22.47	0.0348
3	3	33.11	0.1657	3.948	39.93	2.0583	-22.579	21.89	28.03	0.0145
ADJUSTED:		33.95	0.2071	2.945	33.68 R	2.0000	-21.850	21.85	27.66	0.0222
3	4	38.09	0.1473	4.264	46.63	2.2943	-30.781	26.62	32.65	0.0096
ADJUSTED:		39.09	0.1841	3.287	38.85 R	2.0000	-26.405	26.41	32.70	0.0141
3	5	44.27	0.1101	5.392	62.20	2.0194	-31.118	30.80	38.25	0.0036
ADJUSTED:		48.88+	0.1376	4.598	48.81 R	2.0000	-30.784	30.78	38.00	0.0052
4	4	23.50	0.1281	6.017	34.60	2.2943	-22.831	19.69	26.63	0.0027
ADJUSTED:		26.43	0.1601	5.346	25.47 R	2.0000	-19.407	19.41	26.91	0.0036
4	5	33.02	0.0928	6.809	57.75	2.1511	-26.065	24.11	31.94	0.0012
ADJUSTED:		40.57++	0.1160	6.268	40.47 R	2.0000	-23.943	23.94	32.07	0.0015

APD LINE PARAMETERS TEST 2

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	NO DATA ON FILE								
1	2	39.23	0.4346	-2.904	31.28	3.3771	-65.307	38.18	42.41	0.0139
ADJUSTED:		39.22	0.5432	-5.625	32.48	3.3771	-65.307	38.18	42.12	0.0220
1	3	33.83	0.8415	-8.232	24.20	2.7324	-46.381	33.56	40.35	0.0006
ADJUSTED:		34.04	0.8415	-8.232	24.20	2.7324	-46.381	33.56	40.35	0.0006
2	1	NO DATA ON FILE								
2	2	27.67	1.1777	-11.208	20.92	3.6457	-50.626	27.26	31.94	0.0032
ADJUSTED:		28.17	1.1777	-11.208	20.92	3.6457	-50.626	27.26	31.94	0.0032
2	3	29.25 *	0.6547	-3.012	17.29	3.8391	-57.291	29.33	34.09	0.0015
ADJUSTED:		29.59	0.6547	-3.012	17.29	3.8391	-57.291	29.33	34.09	0.0015
2	4	33.64 *	0.4062	0.455	17.99	3.7467	-66.163	34.80	39.89	0.0008
ADJUSTED:		34.89	0.4062	0.455	17.99	3.7467	-66.163	34.80	39.89	0.0008
2	5	34.30 *	0.1570	5.224	28.44	3.4341	-63.035	36.21	41.66	0.0008
ADJUSTED:		36.88	0.1570	5.224	28.44	3.4341	-63.035	36.21	41.66	0.0008
3	2	17.64	0.3889	1.842	12.39	2.0583	-17.484	16.94	23.15	0.0134
ADJUSTED:		18.21	0.3889	1.842	12.39	R 2.0000	-16.899	16.90	23.26	0.0132
3	3	22.67	0.2805	3.546	12.89	2.0194	-22.122	21.89	29.52	0.0028
ADJUSTED:		22.39	0.2805	3.546	12.89	R 2.0000	-21.873	21.87	29.57	0.0028
3	4	26.99	0.2222	4.521	14.90	2.0194	-26.120	25.85	34.10	0.0011
ADJUSTED:		26.37	0.1852	5.264	17.04	R 2.0000	-25.030	25.83	34.27	0.0009
3	5	32.21	0.1840	4.888	21.49	2.0194	-31.118	30.80	39.24	0.0008
ADJUSTED:		31.92	0.1534	5.585	25.57	R 2.0000	-30.779	30.78	39.38	0.0007
4	4	19.60	0.2805	4.518	5.96	2.0194	-19.123	18.92	27.19	0.0011
ADJUSTED:		19.11	0.2805	4.518	5.96	R 2.0000	-18.900	18.90	27.24	0.0011
4	5	24.51	0.2031	5.271	12.14	2.2087	-26.384	23.73	31.57	0.0009
ADJUSTED:		24.07	0.1692	5.907	15.01	R 2.0000	-23.491	23.49	32.11	0.0007

APD LINE PARAMETERS   TEST 3

FREQ	BW	VRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	NO DATA ON FILE								
1	2	54.04 *	1.3325	-30.711	47.34	999.9900	**********	54.34	54.36	0.0286
ADJUSTED:		55.13	1.3325	-30.711	47.34	999.9900	**********	54.34	54.36	0.0286
1	3	53.34	0.7821	-14.922	43.65	11.2896	-296.601	52.20	53.61	0.0179
ADJUSTED:		53.02	0.9777	-20.613	45.36	11.2896	-296.601	52.20	53.53	0.0276
2	1	17.91	0.0906	7.218	52.17	2.3785	-19.924	16.50	23.73	0.0012
ADJUSTED:		34.09++	0.1133	6.781	34.01	2.3785	-19.924	16.50	23.58	0.0015
2	2	19.88	0.5276	-0.558	14.57	2.6536	-26.602	19.69	24.50	0.0203
ADJUSTED:		20.85	0.5276	-0.558	14.57	2.6536	-26.602	19.69	24.50	0.0203
2	3	24.89	0.3833	0.703	18.76	2.2823	-27.223	23.65	29.41	0.0135
ADJUSTED:		24.88	0.4484	-0.543	19.33	R 2.0000	-23.464	23.46	29.54	0.0173
2	4	27.63	0.5839	-3.829	23.32	2.1842	-30.162	27.47	32.91	0.0227
ADJUSTED:		28.81	0.5839	-3.829	23.32	R 2.0000	-27.374	27.37	33.25	0.0208
2	5	31.77	0.4908	-2.691	25.26	2.4485	-39.135	31.68	37.23	0.0121
ADJUSTED:		32.57	0.4908	-2.691	25.26	2.4485	-39.135	31.68	37.23	0.0121
3	2	23.18	0.3778	-0.071	23.38	2.0456	-17.365	16.94	20.74	0.0885
ADJUSTED:		23.87	-0.4722	-1.776	22.89	R 2.0000	-16.935	16.93	19.84	0.1417
3	3	28.29	0.2326	2.679	28.66	1.9001	-20.318	21.48	27.58	0.0207
ADJUSTED:		28.27	0.2592	2.099	27.23	R 2.0000	-21.537	21.54	27.16	0.0261
3	4	34.61	0.1965	3.149	35.36	2.0583	-26.654	25.85	32.02	0.0141
ADJUSTED:		34.60	0.2096	2.829	33.98	R 2.0000	-25.809	25.81	31.99	0.0158
3	5	34.62	0.1473	4.484	43.67	2.1051	-32.284	30.58	37.56	0.0050
ADJUSTED:		37.59	0.1841	3.492	36.65	R 2.0000	-30.491	30.49	37.43	0.0072
4	4	20.07	0.2181	4.856	12.75	2.1422	-20.646	19.16	26.51	0.0026
ADJUSTED:		20.07	0.2068	5.054	13.37	R 2.0000	-19.018	19.02	26.85	0.0023
4	5	NO DATA ON FILE								

APD LINE PARAMETERS TEST 4

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	NO DATA ON FILE								
1	2	NO DATA ON FILE								
1	3	53.48 *	0.8426	-15.345	41.04	6.9808	-189.216	53.75	56.65	0.0008
ADJUSTED:		53.98	0.8426	-15.345	41.04	6.9808	-189.216	53.75	56.65	0.0008
2	1	21.39	0.9638	-5.912	15.58	4.3685	-47.362	21.16	24.35	0.0219
ADJUSTED:		22.22	0.9638	-5.912	15.58	4.3685	-47.362	21.16	24.35	0.0219
2	2	21.72	0.4528	0.376	14.95	2.5995	-28.608	21.67	27.00	0.0116
ADJUSTED:		22.50	0.4528	0.376	14.95	2.5995	-28.608	21.67	27.00	0.0116
2	3	25.51	0.3104	1.929	19.81	2.5173	-31.145	24.43	29.97	0.0105
ADJUSTED:		25.72	0.3104	1.929	19.81	2.5173	-31.145	24.43	29.97	0.0105
2	4	29.84	0.1614	5.067	28.33	2.2087	-30.757	27.69	35.00	0.0021
ADJUSTED:		29.83	0.1767	4.715	26.04 R	2.0000	-27.478	27.48	35.31	0.0023
2	5	32.35	0.1144	6.085	45.18	2.1511	-34.583	32.03	39.94	0.0010
ADJUSTED:		45.38++	0.1144	6.085	45.18 R	2.0000	-31.860	31.86	40.25	0.0010
3	2	24.77	0.2293	3.124	25.66	1.7725	-15.116	17.31	23.64	0.0217
ADJUSTED:		24.74	0.2617	2.475	23.85 R	2.0000	-17.431	17.43	22.90	0.0294
3	3	33.37	0.1671	3.992	38.66	2.0583	-22.579	21.89	28.10	0.0135
ADJUSTED:		33.36	0.2048	3.089	33.04 R	2.0000	-21.849	21.85	27.78	0.0198
3	4	36.67	0.1593	3.921	43.71	2.1197	-28.406	26.70	32.98	0.0109
ADJUSTED:		37.53	0.1992	2.875	37.16 R	2.0000	-26.618	26.62	32.75	0.0164
3	5	44.13	0.1594	3.641	47.15	2.5995	-41.475	31.57	36.98	0.0105
ADJUSTED:		44.11	0.1756	3.187	43.86	2.5995	-41.475	31.57	36.85	0.0124
4	4	22.99	0.2156	3.762	23.41	2.1197	-21.062	19.77	26.03	0.0106
ADJUSTED:		23.35	0.2695	2.673	20.91 R	2.0000	-19.687	19.69	25.84	0.0161
4	5	30.52	0.1758	4.460	29.29	2.4683	-30.751	24.62	30.72	0.0055
ADJUSTED:		30.51	0.1763	4.448	29.21	2.4683	-30.751	24.62	30.72	0.0055

APD LINE PARAMETERS TEST 5

FREQ	BW	VTRMS	AV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	25.80 *	1.1873	-13.690	24.90	999.9900*	********	26.63	26.64	0.1957
ADJUSTED:		28.80+	1.1873	-13.690	24.90	999.9900*	********	26.63	26.64	0.1957
1	2	32.31 *	0.3022	1.781	21.93	2.6598	-43.930	32.67	38.73	0.0330
ADJUSTED:		33.02	0.3022	1.781	21.93	2.6598	-43.930	32.67	38.78	0.0330
1	3	NO DATA ON FILE								
2	1	21.88	0.2990	1.884	21.72	3.7884	-34.033	17.45	20.59	0.0435
ADJUSTED:		22.32	0.3738	0.530	20.60	3.7884	-34.033	17.45	20.24	0.0672
2	2	24.74	0.1805	4.134	31.07	2.5995	-24.747	18.70	23.88	0.0142
ADJUSTED:		26.85	0.2256	3.177	26.13	2.5995	-24.747	18.70	23.53	0.0217
2	3	29.41	0.1901	3.413	35.05	3.2240	-40.143	24.43	28.71	0.0163
ADJUSTED:		31.59	0.2377	2.293	30.66	3.2240	-40.143	24.43	28.42	0.0253
2	4	34.34	0.1167	5.642	50.55	3.4341	-51.136	29.28	34.23	0.0430
ADJUSTED:		39.43+	0.1459	4.892	38.99	3.4341	-51.136	29.28	34.03	0.0042
2	5	34.86	0.1436	4.783	41.91	3.0269	-49.385	32.18	37.57	0.0037
ADJUSTED:		36.65	0.1796	3.838	34.73	3.0269	-49.385	32.18	37.38	0.0053
3	2	19.29	0.2511	3.192	20.31	1.6871	-14.104	17.11	24.09	0.0152
ADJUSTED:		21.08	0.3139	2.007	18.86	1.6871	-14.104	17.11	23.46	0.0246
3	3	23.04	0.2628	2.657	22.25	2.0583	-22.579	21.89	28.11	0.0134
ADJUSTED:		24.57	0.3285	1.320	21.25 R	2.0000	-21.849	21.85	27.72	0.0209
3	4	27.85	0.1785	4.539	27.34	2.0194	-26.120	25.85	33.31	0.0036
ADJUSTED:		27.88	0.2231	3.529	23.62 R	2.0000	-25.834	25.83	33.05	0.0052
3	5	32.31	0.2573	1.497	32.31	2.6536	-41.051	30.58	35.51	0.0176
ADJUSTED:		33.77	0.3217	-0.092	30.93	2.6536	-41.051	30.58	35.13	0.0274
4	4	19.35	0.2677	4.278	9.25	2.0194	-19.123	18.92	26.72	0.0022
ADJUSTED:		19.35	0.2677	4.278	9.25 R	2.0000	-18.902	18.90	26.76	0.0022
4	5	24.89	0.1472	6.162	20.91	2.2087	-26.384	23.73	31.58	0.0009
ADJUSTED:		24.89	0.1553	6.001	19.28 R	2.0000	-23.490	23.49	31.97	0.0009

APD LINE PARAMETERS TEST 6

FREQ	BW	VTRMS	AV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	NO DATA ON FILE								
1	2	56.24	1.1777	-25.782	45.67	25.5301	-717.641	56.04	56.82	0.0029
ADJUSTED:		56.42	1.1777	-25.782	45.67	25.5301	-717.641	56.04	56.82	0.0029
1	3	55.13	1.1776	-26.362	46.66	11.1039	-307.094	54.97	56.56	0.0071
ADJUSTED:		55.57	1.1776	-26.362	46.66	11.1039	-307.094	54.97	56.56	0.0071
2	1	17.59	0.6199	-1.114	12.64	2.9550	-26.360	17.41	21.62	0.0267
ADJUSTED:		18.66	0.6199	-1.114	12.64	2.9550	-26.360	17.41	21.62	0.0267
2	2	22.15 *	0.3891	0.772	17.87	13.4325	-158.127	23.24	24.36	0.0285
ADJUSTED:		24.35	0.3891	0.772	17.87	13.4325	-158.127	23.24	24.36	0.0285
2	3	25.93 *	0.3361	1.230	20.85	5.3130	-72.790	26.89	29.75	0.0150
ADJUSTED:		27.85	0.3361	1.230	20.85	5.3130	-72.790	26.89	29.75	0.0150
2	4	29.94 *	0.4023	-0.824	24.68	4.3093	-67.596	30.84	34.18	0.0178
ADJUSTED:		31.78	0.4023	-0.824	24.68	4.3093	-67.596	30.84	34.18	0.0178
2	5	34.79 *	0.2973	0.657	30.24	6.4684	-117.511	35.86	38.30	0.0134
ADJUSTED:		36.91	0.2973	0.657	30.24	6.4684	-117.511	35.86	38.30	0.0134
3	2	20.38	0.2896	2.474	19.11	2.0289	-16.212	15.96	21.49	0.0268
ADJUSTED:		20.35	0.3319	1.723	18.40 R	2.0000	-15.941	15.94	21.18	0.0354
3	3	25.53	0.2651	2.303	24.51	2.0289	-21.233	20.91	26.69	0.0216
ADJUSTED:		25.50	0.2951	1.686	23.66 R	2.0000	-20.889	20.89	26.48	0.0266
3	4	28.17	0.2307	2.583	29.98	1.8543	-22.969	24.93	31.48	0.0153
ADJUSTED:		29.62	0.2884	1.251	27.78 R	2.0000	-25.018	25.02	30.70	0.0248
3	5	36.49	0.2220	2.473	33.41	2.0583	-30.730	29.81	36.16	0.0116
ADJUSTED:		36.48	0.1989	3.054	35.44 R	2.0000	-29.767	29.77	36.45	0.0095
4	4	20.01	0.1900	5.258	15.69	2.0328	-19.129	18.79	26.47	0.0025
ADJUSTED:		20.00	0.2138	4.826	13.96 R	2.0000	-18.757	18.76	26.41	0.0030
4	5	24.62	0.1614	5.707	20.42	2.2943	-27.374	23.65	31.02	0.0013
ADJUSTED:		24.62	0.1734	5.465	18.69 R	2.0000	-23.336	23.34	31.54	0.0014

APD LINE PARAMETERS TEST 7

FREQ	BW	VTRMS	MV	KV	VVRMS		MA	KA	VARMS	INTERSECT: DB	PROB
1	1	37.93 *	0.7851	-9.282	29.09		4.8922	-102.292	41.30	45.29	0.0008
ADJUSTED:		41.55*	0.7851	-9.282	29.09		4.8922	-102.292	41.30	45.29	0.0008
1	2	42.09	0.9067	-13.751	34.20		2.7324	-57.201	41.48	47.60	0.0023
ADJUSTED:		42.23	0.9467	-13.751	34.20		2.7324	-57.201	41.48	47.60	0.0023
1	3	42.80	0.3467	-0.246	28.13		2.7324	-57.201	41.48	47.75	0.0017
ADJUSTED:		41.75	0.4334	-2.517	29.61		2.7324	-57.201	41.48	47.57	0.0024
2	1	20.86	1.5789	-13.307	17.44		3.2964	-33.900	20.08	23.98	0.0260
ADJUSTED:		21.97	1.5789	-13.307	17.44		3.2964	-33.900	20.08	23.98	0.0260
2	2	22.15 *	0.8415	-4.066	14.30		3.1103	-36.541	23.04	28.63	0.0019
ADJUSTED:		23.58	0.8415	-4.066	14.30		3.1103	-36.541	23.04	28.63	0.0019
2	3	29.41	0.2508	3.203	20.27		3.0792	-43.779	27.98	33.22	0.0043
ADJUSTED:		28.98	0.2390	4.087	22.12		3.0792	-43.779	27.98	33.35	0.0033
2	4	27.25	0.2310	4.270	15.31		2.0194	-27.120	26.84	35.10	0.0011
ADJUSTED:		27.12	0.2310	4.270	15.31	R	2.0000	-26.820	26.82	35.15	0.0011
2	5	31.46	0.3184	2.080	17.82		2.1511	-33.518	31.04	38.85	0.0012
ADJUSTED:		31.08	0.3184	2.080	17.82	R	2.0000	-30.874	30.87	39.19	0.0011
3	2	22.24	0.2861	2.229	21.36		1.9955	-16.603	17.52	23.26	0.0275
ADJUSTED:		22.23	0.3459	1.109	20.41	R	2.0000	-17.564	17.56	22.58	0.0419
3	3	25.19	0.2259	3.291	25.33		1.9039	-18.790	19.83	26.32	0.0145
ADJUSTED:		25.17	0.2514	2.767	23.63	R	2.0000	-19.896	19.90	25.92	0.0182
3	4	30.89	0.1870	3.772	32.44		1.8714	-22.240	23.90	30.89	0.0097
ADJUSTED:		30.86	0.2112	3.203	29.86	R	2.0000	-23.998	24.00	30.42	0.0125
3	5	31.56	0.1491	4.846	37.63		2.0328	-29.191	28.69	36.14	0.0034
ADJUSTED:		33.13	0.1864	3.983	31.21	R	2.0000	-28.659	28.66	35.92	0.0049
4	4	20.14	0.3464	1.037	20.76		2.0289	-19.225	18.93	24.09	0.0362
ADJUSTED:		22.86	0.4330	-0.561	20.62	R	2.0000	-18.914	18.91	23.42	0.0593
4	5	24.73	0.3020	2.982	14.41		2.0328	-24.160	23.74	31.36	0.0027
ADJUSTED:		24.23	0.3775	1.556	14.79	R	2.0000	-23.700	23.71	31.14	0.0039

APD LINE PARAMETERS TEST 8

FREQ	BW	VTRMS	AV	KV	VVRMS	AA	KA	VARMS	INTERSECT, DB	PROB
1	1	43.46 *	0.4913	-3.676	29.23	4.7780	-105.570	43.67	47.54	0.0018
ADJUSTED:		43.82	0.4913	-3.676	29.23	4.7780	-105.570	43.67	47.54	0.0018
1	2	45.82 *	0.3926	-1.528	29.28	6.1895	-150.000	47.98	51.22	0.0008
ADJUSTED:		48.04	0.3926	-1.528	29.28	6.1895	-150.000	47.98	51.22	0.0008
1	3	44.42 *	0.9327	-17.760	39.30	3.6951	-87.157	46.66	51.17	0.0042
ADJUSTED:		47.37	0.9327	-17.760	39.30	3.6951	-87.157	46.66	51.17	0.0042
2	1	24.30	0.5298	-1.747	18.95	6.7597	-81.171	23.55	25.50	0.0421
ADJUSTED:		24.80	0.5038	-1.302	18.77	6.7597	-81.171	23.55	25.53	0.0384
2	2	26.37	0.3197	1.437	21.68	3.7884	-45.285	23.39	26.94	0.0234
ADJUSTED:		26.17	0.2664	2.480	22.91	3.7884	-45.285	23.39	27.12	0.0171
2	3	31.02	0.2113	3.123	30.64	2.5995	-35.042	26.62	31.96	0.0115
ADJUSTED:		31.00	0.2345	2.579	29.04	2.5995	-35.042	26.62	31.81	0.0139
2	4	31.55	0.1339	5.199	42.77	2.8528	-43.931	30.38	36.14	0.0031
ADJUSTED:		35.84+	0.1674	4.341	34.39	2.8528	-43.931	30.38	35.95	0.0044
2	5	39.51	0.1202	5.482	49.80	3.4341	-59.636	34.23	39.30	0.0023
ADJUSTED:		40.51	0.1503	4.667	39.34	3.4341	-59.636	34.23	39.16	0.0031
3	2	27.03	0.2019	3.431	30.64	2.0289	-17.216	16.95	22.60	0.0241
ADJUSTED:		27.06	0.2515	2.389	26.62 R	2.0000	-16.930	16.93	22.10	0.0374
3	3	31.58	0.1684	3.979	38.18	2.1197	-23.160	21.75	27.82	0.0137
ADJUSTED:		32.63	0.2105	2.977	32.27 R	2.0000	-21.674	21.67	27.55	0.0209
3	4	36.39	0.1605	3.988	42.22	2.1197	-27.357	25.71	32.00	0.0108
ADJUSTED:		36.36	0.1990	2.999	35.98 R	2.0000	-25.627	25.63	31.79	0.0160
3	5	35.85	0.1167	5.412	54.53	2.2943	-35.324	30.58	37.41	0.0032
ADJUSTED:		43.16++	0.1458	4.606	42.93 R	2.0000	-30.306	30.31	37.66	0.0044
4	4	22.59	0.0920	7.161	51.27	2.0194	-19.123	18.92	27.27	0.0010
ADJUSTED:		34.09++	0.1150	6.093	33.96 R	2.0000	-18.899	18.90	27.15	0.0012
4	5	24.61	0.0842	7.436	57.78	2.1921	-26.170	23.73	31.89	0.0005
ADJUSTED:		33.13++	0.1053	6.990	37.98 R	2.0000	-23.491	23.49	32.18	0.0006

APD LINE PARAMETERS TEST 9

FREQ	BW	VTRMS	AV	KV	VVRMS	MA	KA	VARMS	INTERSECT, DB	PROB
1	1	31.68	0.5774	-3.324	21.95	6.4684	-98.300	29.92	32.24	0.0189
ADJUSTED:		30.81	0.7218	-6.108	23.49	6.4684	-98.300	29.92	32.09	0.0295
1	2	34.87	0.4271	-1.601	25.93	4.1378	-70.748	33.67	37.27	0.0133
ADJUSTED:		34.55	0.5339	-4.002	27.16	4.1378	-70.748	33.67	37.04	0.0207
1	3	34.87 *	0.1931	4.117	26.62	3.1260	-56.353	35.59	41.24	0.0016
ADJUSTED:		36.11	0.1931	4.117	26.62	3.1260	-56.353	35.59	41.24	0.0016
2	1	26.04 *	0.4233	-0.357	20.47	8.6186	-114.331	26.12	27.81	0.0281
ADJUSTED:		27.17	0.4233	-0.357	20.47	8.6186	-114.331	26.12	27.81	0.0281
2	2	28.28	0.2477	2.618	25.61	3.5267	-45.921	25.54	29.61	0.0143
ADJUSTED:		28.27	0.2646	2.252	24.97	3.5267	-45.921	25.54	29.54	0.0161
2	3	29.58	0.2112	3.099	30.89	3.0280	-41.529	26.98	31.69	0.0121
ADJUSTED:		30.55	0.2640	1.863	28.04	3.0280	-41.529	26.98	31.40	0.0185
2	4	32.35	0.1530	4.688	37.46	2.2186	-34.675	31.09	38.11	0.0032
ADJUSTED:		34.27	0.1913	3.700	31.61 R	2.0000	-30.884	30.88	38.24	0.0043
2	5	37.14	0.1061	5.906	57.54	2.6229	-44.202	33.35	39.82	0.0018
ADJUSTED:		44.40++	0.1327	5.174	44.05	2.6229	-44.202	33.35	39.66	0.0024
3	2	26.53	0.2153	3.285	27.92	2.0289	-17.216	16.95	22.61	0.0239
ADJUSTED:		26.51	0.2400	2.782	26.01 R	2.0000	-16.930	16.93	22.40	0.0295
3	3	30.11	0.1804	3.668	36.28	2.0583	-22.579	21.89	27.95	0.0156
ADJUSTED:		31.71	0.2255	2.604	31.23 R	2.0000	-21.851	21.85	27.56	0.0241
3	4	36.54	0.1167	5.527	52.55	2.1951	-28.116	26.62	33.84	0.0036
ADJUSTED:		40.92+	0.1458	4.765	40.76 R	2.0000	-26.525	26.52	33.75	0.0051
3	5	39.25	0.0873	6.360	77.23	2.4683	-39.304	31.55	38.36	0.0017
ADJUSTED:		57.07++	0.1091	5.741	57.36	2.4683	-39.304	31.55	38.19	0.0023
4	4	24.84	0.0966	6.929	49.72	2.1511	-20.741	19.16	26.94	0.0013
ADJUSTED:		33.85++	0.1207	6.425	33.70 R	2.0000	-18.995	19.00	27.05	0.0017
4	5	27.38	0.0733	7.579	77.79	1.9675	-23.445	23.86	32.76	0.0005
ADJUSTED:		51.73++	0.0916	7.171	51.72 R	2.0000	-23.906	23.91	32.57	0.0006

APD LINE PARAMETERS TEST 10

FREQ	BW	VTRMS	AV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	NO DATA ON FILE								
1	2	53.37 *	0.6304	-9.649	39.35	11.4069	-309.192	53.87	55.59	0.0022
ADJUSTED:		54.02	0.6304	-9.649	39.35	11.4069	-309.192	53.87	55.59	0.0022
1	3	NO DATA ON FILE								
2	1	18.44 *	0.7281	-2.860	14.30	1.7839	-16.399	18.63	25.61	0.0118
ADJUSTED:		20.10	0.7281	-2.860	14.30 R	2.0000	-18.777	18.78	25.03	0.0147
2	2	21.03	0.5129	-0.620	15.57	2.1197	-21.062	19.77	25.44	0.0204
ADJUSTED:		21.03	0.4791	-0.065	15.23 R	2.0000	-19.706	19.71	25.83	0.0167
2	3	24.22	0.4414	-0.405	19.24	2.1197	-25.259	23.73	29.62	0.0165
ADJUSTED:		25.00	0.4414	-0.405	19.24 R	2.0000	-23.659	23.66	29.84	0.0158
2	4	28.98	0.3597	0.462	22.49	2.1197	-29.456	27.69	34.00	0.0106
ADJUSTED:		28.98	0.4496	-1.455	23.30 R	2.0000	-27.607	27.61	33.74	0.0165
2	5	32.22 *	0.4208	-1.169	24.54	1.9250	-31.004	32.29	39.67	0.0054
ADJUSTED:		33.02	0.4208	-1.169	24.54 R	2.0000	-32.353	32.35	39.49	0.0057
3	2	26.05	0.3123	0.938	25.91	1.5582	-13.797	18.34	23.65	0.0547
ADJUSTED:		26.02	0.3489	0.212	25.21	1.5582	-13.797	18.34	23.17	0.0698
3	3	30.12	0.2582	1.706	30.50	1.7627	-20.081	23.06	28.96	0.0301
ADJUSTED:		30.09	0.2969	0.835	29.11 R	2.0000	-23.152	23.15	28.17	0.0418
3	4	33.43	0.2155	2.565	34.55	1.6871	-22.455	27.01	34.00	0.0150
ADJUSTED:		33.40	0.2533	1.623	32.27	1.6871	-22.455	27.01	33.59	0.0209
3	5	34.82	0.2214	1.913	38.64	2.0625	-32.159	31.13	37.01	0.0185
ADJUSTED:		37.13	0.2767	0.434	35.89 R	2.0000	-31.093	31.09	36.59	0.0289
4	4	21.47	0.1964	4.972	16.86	2.0194	-20.123	19.91	27.53	0.0029
ADJUSTED:		21.47	0.2036	4.836	16.29 R	2.0000	-19.893	19.89	27.53	0.0030
4	5	25.69	0.1759	5.241	20.37	2.2943	-28.510	24.64	31.86	0.0017
ADJUSTED:		25.69	0.1794	5.169	19.96 R	2.0000	-24.337	24.34	32.41	0.0016

APD LINE PARAMETERS TEST 11

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	35.60	1.1778	-15.290	27.85	3.8391	-66.793	34.28	38.70	0.0036
ADJUSTED:		35.58	1.4722	-21.256	29.70	3.8391	-66.793	34.28	38.48	0.0062
1	2	34.80	0.6200	-5.039	25.30	2.4683	-42.969	34.52	41.04	0.0028
ADJUSTED:		35.01	0.6200	-5.039	25.30	2.4683	-42.969	34.52	41.04	0.0028
1	3	35.52 *	0.6369	-7.034	30.65	2.6316	-48.249	36.31	41.32	0.0166
ADJUSTED:		37.36	0.6369	-7.034	30.65	2.6316	-48.249	36.31	41.32	0.0166
2	1	22.61	0.3278	2.056	16.86	2.8606	-31.055	21.30	26.15	0.0135
ADJUSTED:		22.63	0.3278	2.056	16.86	2.8606	-31.055	21.30	26.15	0.0135
2	2	22.32	0.2384	3.364	21.48	2.2902	-23.548	20.35	26.23	0.0116
ADJUSTED:		23.03	0.2980	2.181	19.88 R	2.0000	-20.153	20.15	26.25	0.0171
2	3	30.51	0.1683	4.568	31.24	3.7467	-56.890	29.85	34.35	0.0038
ADJUSTED:		33.61+	0.1683	4.568	31.24	3.7467	-56.890	29.85	34.35	0.0038
2	4	33.30 *	0.1870	4.050	29.47	3.3024	-56.287	33.60	38.73	0.0029
ADJUSTED:		35.02	0.1870	4.050	29.47	3.3024	-56.287	33.60	38.73	0.0029
2	5	35.05 *	0.1592	4.595	35.30	4.0529	-75.284	36.63	41.03	0.0022
ADJUSTED:		39.02+	0.1592	4.595	35.30	4.0529	-75.284	36.63	41.03	0.0022
3	2	17.34	0.2988	2.404	16.95	1.7627	-12.228	14.15	20.40	0.0233
ADJUSTED:		18.29	0.3610	1.589	16.10 R	2.0000	-14.262	14.26	19.34	0.0399
3	3	22.42	0.2031	4.166	23.03	1.7696	-16.594	19.02	26.50	0.0078
ADJUSTED:		22.69	0.2539	3.151	20.11 R	2.0000	-19.201	19.20	25.60	0.0127
3	4	27.74	0.2459	2.585	26.28	2.2205	-26.083	23.32	29.04	0.0162
ADJUSTED:		27.73	0.2558	2.370	25.85 R	2.0000	-23.186	23.19	29.30	0.0167
3	5	30.58	0.1614	4.668	33.28	2.1522	-30.494	28.21	35.32	0.0035
ADJUSTED:		31.13	0.2018	3.687	28.16 R	2.0000	-28.071	28.07	35.32	0.0049
4	4	21.90	0.1167	6.451	36.69	2.2943	-21.696	18.70	25.85	0.0019
ADJUSTED:		26.47+	0.1459	5.859	25.73 R	2.0000	-18.402	18.40	26.17	0.0025
4	5	23.75	0.0942	6.931	52.96	2.2242	-26.121	23.32	31.04	0.0010
ADJUSTED:		52.97++	0.0942	6.931	52.96 R	2.0000	-23.065	23.06	31.48	0.0010

APD LINE PARAMETERS TEST 12

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	34.27	0.1053	6.572	45.93	3.3282	-57.445	34.03	39.73	0.0006
ADJUSTED:		46.20++	0.1053	6.572	45.93	3.3282	-57.445	34.03	39.73	0.0006
1	2	35.40	0.8710	-10.993	29.51	3.3771	-60.292	35.21	39.34	0.0164
ADJUSTED:		36.25	0.8710	-10.993	29.51	3.3771	-60.292	35.21	39.34	0.0164
1	3	35.40	0.4355	-2.231	28.08	2.5995	-45.674	34.80	40.15	0.0113
ADJUSTED:		35.63	0.4355	-2.231	28.08	2.5995	-45.674	34.80	40.15	0.0113
2	1	16.24	0.4383	1.044	12.87	2.2005	-16.242	14.61	19.62	0.0326
ADJUSTED:		16.74	0.3653	2.124	12.77 R	2.0000	-14.519	14.52	20.36	0.0215
2	2	21.52	0.2786	2.900	17.78	2.2850	-21.981	19.03	24.80	0.0133
ADJUSTED:		21.51	0.2648	3.155	18.13 R	2.0000	-18.842	18.84	25.35	0.0114
2	3	27.08	0.2463	2.895	23.68	3.3771	-43.575	25.31	29.69	0.0109
ADJUSTED:		27.09	0.3478	1.595	22.34	3.3771	-43.575	25.31	29.43	0.0166
2	4	29.11 *	0.1841	4.339	27.43	2.5244	-38.132	29.89	36.30	0.0028
ADJUSTED:		31.81	0.1341	4.339	27.43	2.5244	-38.132	29.89	36.30	0.0028
2	5	30.51	0.1154	5.499	30.91	2.2887	-32.943	29.67	37.26	0.0013
ADJUSTED:		30.73	0.1818	4.639	24.99 R	2.0000	-29.443	29.44	37.49	0.0017
3	2	22.67	0.2371	2.236	21.14	2.0289	-16.212	15.96	21.18	0.0344
ADJUSTED:		22.66	0.2734	2.487	21.62 R	2.0000	-15.943	15.94	21.35	0.0311
3	3	27.90	0.1363	3.837	32.04	2.1197	-22.111	20.76	26.84	0.0135
ADJUSTED:		28.41	0.2328	2.796	27.61 R	2.0000	-20.684	20.68	26.57	0.0206
3	4	32.90	0.1551	4.452	39.37	2.0194	-25.121	24.86	31.73	0.0074
ADJUSTED:		33.45	0.1938	3.496	32.80 R	2.0000	-24.847	24.85	31.38	0.0111
3	5	40.33	0.1324	4.935	47.90	2.2943	-34.188	29.59	36.19	0.0045
ADJUSTED:		40.36	0.1597	4.198	40.00 R	2.0000	-29.333	29.33	36.44	0.0059
4	4	21.47	0.1437	5.849	27.05	2.0194	-19.123	18.92	26.63	0.0025
ADJUSTED:		22.65	0.1796	5.135	20.27 R	2.0000	-18.902	18.90	26.41	0.0036
4	5	26.46	0.1031	6.671	41.06	2.0194	-24.121	23.87	32.22	0.0010
ADJUSTED:		30.02+	0.1351	6.081	28.81 R	2.0000	-23.849	23.85	32.10	0.0013

APD LINE PARAMETERS TEST 15

FREQ	BW	VRMS	AV	KV	VVRMS	AA	KA	VARMS	INTERSECT: DB	PROB
1	1	27.56	0.6931	-6.331	25.43	6.7842	-93.874	27.21	28.74	0.0996
ADJUSTED:		29.42	0.6931	-6.331	25.43	6.7842	-93.874	27.21	28.74	0.0996
1	2	30.03	0.2757	1.933	25.24	3.3771	-48.590	28.28	32.58	0.0124
ADJUSTED:		30.03	0.2757	1.933	25.24	3.3771	-48.590	28.28	32.58	0.0124
1	3	39.75	0.3020	0.590	29.85	4.3509	-82.911	37.58	41.25	0.0082
ADJUSTED:		38.40	0.2517	1.863	30.75	4.3509	-82.911	37.58	41.36	0.0061
2	1	25.94 *	0.4689	-0.603	18.15	6.4684	-85.493	25.96	28.30	0.0181
ADJUSTED:		26.62	0.4689	-0.603	18.15	6.4684	-85.493	25.96	28.30	0.0181
2	2	27.73	0.2509	2.543	25.51	4.1123	-56.725	27.06	30.70	0.0128
ADJUSTED:		29.37	0.2509	2.543	25.51	4.1123	-56.725	27.06	30.70	0.0128
2	3	30.58	0.2357	2.635	28.28	2.5995	-36.328	27.61	32.97	0.0113
ADJUSTED:		30.57	0.2531	2.231	27.51	2.5995	-36.328	27.61	32.87	0.0128
2	4	33.39	0.1614	4.588	34.27	2.2322	-33.646	29.97	36.93	0.0033
ADJUSTED:		33.37	0.1341	4.022	30.89 R	2.0300	-29.752	29.75	37.20	0.0039
2	5	36.55	0.1166	5.528	52.56	2.4461	-41.861	33.94	40.69	0.0021
ADJUSTED:		42.15+	0.1158	4.717	41.44	2.4461	-41.861	33.94	40.50	0.0029
3	2	24.93	0.2371	3.216	23.92	2.0301	-17.709	17.42	23.34	0.0190
ADJUSTED:		24.91	0.2221	3.507	24.07 R	2.0300	-17.401	17.40	23.52	0.0167
3	3	29.89	0.1713	4.116	35.20	2.0583	-22.579	21.89	28.29	0.0110
ADJUSTED:		30.44	0.2141	3.122	29.80 R	2.0200	-21.846	21.85	27.96	0.0168
3	4	31.11	0.1267	5.442	44.70	2.0328	-27.179	26.71	34.23	0.0031
ADJUSTED:		35.69+	0.1584	4.646	35.11 R	2.0000	-26.679	26.68	34.02	0.0044
3	5	36.11	0.1101	5.883	53.29	2.0194	-31.118	30.80	38.76	0.0018
ADJUSTED:		41.25+	0.1376	5.146	40.84 R	2.0000	-30.781	30.78	38.58	0.0024
4	4	21.82	0.1253	6.493	29.08	2.1511	-21.806	20.15	27.94	0.0013
ADJUSTED:		23.14	0.1567	5.878	20.27 R	2.0000	-19.985	19.98	28.06	0.0016
4	5	28.52	0.1053	6.937	39.00	2.2672	-30.429	26.65	34.57	0.0005
ADJUSTED:		29.54	0.1316	6.367	26.73 R	2.0000	-26.327	26.33	35.00	0.0006

APD LINE PARAMETERS TEST 16

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	32.13	0.7995	-9.928	30.06	2.4719	-36.989	29.63	32.36	0.1355
ADJUSTED:		32.56	0.6662	-7.219	29.46	2.4719	-36.989	29.63	32.97	0.0926
1	2	38.65	0.6555	-9.738	37.77	2.4719	-41.883	33.59	35.39	0.2154
ADJUSTED:		39.18	0.6555	-9.738	37.77	2.4719	-41.883	33.59	35.39	0.2154
1	3	43.71	0.5595	-9.248	43.20	2.3956	-42.962	35.60	36.92	0.2622
ADJUSTED:		43.79	0.7119	-12.923	43.07	2.3956	-42.962	35.60	35.69	0.3867
2	1	38.06	0.6845	-10.128	36.95	1.1978	-18.706	33.02	33.42	0.2586
ADJUSTED:		38.43	0.6845	-10.128	36.95	1.1978	-18.706	33.02	33.42	0.2586
2	2	42.61	0.4515	-5.668	41.81	1.2359	-19.302	32.85	34.76	0.1917
ADJUSTED:		42.60	0.4253	-4.998	42.12	1.2359	-19.302	32.85	35.29	0.1633
2	3	46.88	0.3497	-3.494	46.30	1.6424	-26.194	32.36	35.12	0.1589
ADJUSTED:		46.88	0.3365	-3.129	46.72	1.6424	-26.194	32.36	35.32	0.1479
2	4	50.79	0.2749	-1.608	51.15	1.7361	-29.975	34.84	38.83	0.0941
ADJUSTED:		50.78	0.2836	-1.869	50.67	1.7361	-29.975	34.84	38.70	0.1042
2	5	56.72	0.2377	-0.944	57.88	2.0456	-39.641	38.72	42.81	0.0745
ADJUSTED:		56.71	0.2528	-1.440	56.64	R 2.0000	-38.712	38.71	42.66	0.0834
3	2	27.39	0.3790	-0.874	27.49	1.6535	-14.373	17.83	21.18	0.1274
ADJUSTED:		27.36	0.4324	-1.899	26.95	1.6535	-14.373	17.83	20.43	0.1676
3	3	32.16	0.3209	-0.327	32.53	1.4024	-14.895	22.26	26.94	0.0314
ADJUSTED:		32.13	0.3617	-1.238	31.66	1.4024	-14.895	22.26	26.25	0.1061
3	4	36.78	0.2565	0.848	37.98	2.0456	-26.478	25.85	30.58	0.0438
ADJUSTED:		36.77	0.2713	0.531	36.40	R 2.0000	-25.834	25.83	30.50	0.0534
3	5	39.26	0.2237	1.357	42.88	1.7627	-26.189	29.99	35.80	0.0322
ADJUSTED:		40.05	0.2796	-0.173	39.61	R 2.0000	-30.076	30.08	34.76	0.0527
4	4	25.18	0.1370	4.327	26.50	1.6549	-16.238	20.06	28.02	0.0071
ADJUSTED:		25.16	0.2192	3.645	23.56	1.6549	-16.238	20.06	27.70	0.0095
4	5	27.31	0.1683	4.485	32.23	1.7696	-21.850	24.96	32.89	0.0049
ADJUSTED:		29.40	0.2104	3.499	27.34	R 2.0000	-25.167	25.17	32.04	0.0077

APD LINE PARAMETERS TEST 17

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	32.56	0.7212	-8.314	29.63	3.7783	-59.551	31.01	33.52	0.0922
ADJUSTED:		33.12	0.6310	-5.810	28.97	3.7783	-59.551	31.01	33.83	0.0655
1	2	35.53	0.6048	-7.259	33.52	2.4719	-40.660	32.60	35.78	0.1033
ADJUSTED:		35.94	0.5040	-4.949	33.23	2.4719	-40.660	32.60	36.29	0.0722
1	3	39.12	0.4605	-4.941	37.56	4.9946	-84.652	33.38	35.16	0.1265
ADJUSTED:		39.11	0.4283	-4.147	37.76	4.9946	-84.652	33.38	35.26	0.1120
2	1	33.24	0.6286	-7.459	32.52	4.8939	-77.276	31.06	32.74	0.1467
ADJUSTED:		34.73	0.5239	-5.176	32.39	4.8939	-77.276	31.06	33.00	0.1084
2	2	37.90	0.4156	-4.455	37.11	4.2637	-71.092	32.82	34.91	0.1167
ADJUSTED:		38.42	0.5569	-7.189	37.03	4.2637	-71.092	32.82	34.48	0.1751
2	3	44.78	0.3112	-1.625	42.55	2.6316	-49.551	37.30	41.31	0.0487
ADJUSTED:		44.77	0.2719	-0.507	43.91	2.6316	-49.551	37.30	41.57	0.0381
2	4	47.05	0.2575	-0.521	47.95	5.2765	-110.420	41.34	43.79	0.0388
ADJUSTED:		47.15	0.3219	-2.496	45.83	5.2765	-110.420	41.34	43.56	0.0591
2	5	54.81	0.2516	-0.902	52.74	5.2765	-126.091	47.28	49.83	0.0320
ADJUSTED:		54.80	0.2331	-0.284	53.96	5.2765	-126.091	47.28	49.89	0.0280
3	2	25.16	0.3724	-0.273	25.05	2.0456	-19.390	18.92	22.85	0.0819
ADJUSTED:		25.61	0.4655	-2.045	24.57	R 2.0000	-18.913	18.91	21.99	0.1315
3	3	30.24	0.2753	1.379	29.35	1.7725	-20.381	23.25	29.07	0.0317
ADJUSTED:		30.21	0.2791	1.294	29.21	R 2.0000	-23.342	23.34	28.63	0.0344
3	4	33.81	0.2216	2.181	36.15	1.8543	-25.723	27.90	34.18	0.0192
ADJUSTED:		34.45	0.2770	0.778	33.34	R 2.0000	-27.979	27.98	33.38	0.0311
3	5	36.47	0.2021	2.426	40.53	1.9796	-31.734	32.08	38.44	0.0139
ADJUSTED:		38.25	0.2526	1.039	37.06	R 2.0000	-32.093	32.09	37.92	0.0218
4	4	24.46	0.2142	3.797	23.46	1.9250	-19.570	20.41	27.32	0.0091
ADJUSTED:		24.45	0.2336	3.400	22.23	R 2.0000	-20.464	20.46	27.02	0.0108
4	5	30.98	0.1659	4.493	33.23	2.0194	-25.121	24.86	31.96	0.0056
ADJUSTED:		30.95	0.1896	3.936	29.73	R 2.0000	-24.845	24.85	31.80	0.0070

APD LINE PARAMETERS TEST 18

FREQ	BW	VTRMS	AV	KV	VVRMS		AA	KA	VARMS	INTERSECT: DB	PROB
1	1	16.69	0.6431	-1.788	13.95		2.0456	-15.340	14.96	19.32	0.0626
ADJUSTED:		17.20	0.5359	-0.316	13.26	R	2.0000	-14.948	14.95	19.99	0.0411
1	2	20.21	0.5579	-1.588	16.87		2.0456	-17.365	16.94	21.21	0.0666
ADJUSTED:		20.21	0.6491	-2.993	17.45	R	2.0000	-16.930	16.93	20.63	0.0957
1	3	24.51	0.3320	-0.119	23.19		1.7627	-20.081	23.06	28.92	0.0311
ADJUSTED:		26.18	0.3320	-0.119	23.19	R	2.0000	-23.149	23.15	28.47	0.0333
2	1	30.04	0.5784	-6.010	29.81		1.2423	-13.461	23.26	23.15	0.2910
ADJUSTED:		30.58	0.7480	-8.832	29.69		1.2423	-13.461	23.26	18.73	0.5186
2	2	35.04	0.3497	-2.333	33.75		1.6424	-18.877	23.45	26.42	0.1478
ADJUSTED:		35.04	0.3163	-1.380	34.72		1.6424	-18.877	23.45	27.00	0.1181
2	3	39.99	0.2789	-0.220	40.10		1.6498	-21.263	26.23	30.70	0.0783
ADJUSTED:		39.99	0.2350	-0.374	39.80		1.6498	-21.263	26.23	30.61	0.0817
2	4	43.09	0.2170	1.293	45.79		1.5605	-22.009	28.83	34.69	0.0406
ADJUSTED:		43.07	0.2526	0.300	42.90		1.5605	-22.009	28.83	34.11	0.0556
2	5	44.60	0.1900	1.981	50.16		2.2159	-37.430	33.62	38.91	0.0248
ADJUSTED:		45.53	0.2375	0.558	45.30	R	2.0000	-33.507	33.51	38.66	0.0379
3	2	27.97	0.3506	-0.347	28.18		1.6535	-14.373	17.83	21.53	0.1106
ADJUSTED:		27.95	0.3892	-1.105	27.50		1.6535	-14.373	17.83	20.99	0.1373
3	3	32.89	0.2828	0.704	32.70		2.0456	-22.428	21.89	26.24	0.0632
ADJUSTED:		32.89	0.2368	0.611	32.53	R	2.0000	-21.879	21.88	26.25	0.0646
3	4	35.37	0.2080	2.331	39.30		2.0289	-27.259	26.85	32.50	0.0241
ADJUSTED:		36.13	0.2599	0.994	35.59	R	2.0000	-26.830	26.83	31.98	0.0379
3	5	47.03	0.1615	3.220	51.16		1.8543	-30.312	32.85	39.62	0.0125
ADJUSTED:		47.00	0.1845	2.538	46.83	R	2.0000	-32.946	32.95	39.09	0.0163
4	4	24.16	0.2113	3.750	24.70		2.1197	-21.062	19.77	26.00	0.0115
ADJUSTED:		24.14	0.2548	2.858	22.22	R	2.0000	-19.689	19.69	25.84	0.0162
4	5	28.72	0.1708	4.392	32.23		2.0319	-25.414	24.34	31.19	0.0062
ADJUSTED:		29.11	0.2134	3.401	27.38	R	2.0000	-24.275	24.27	30.98	0.0092

APD LINE PARAMETERS TEST 19

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	11.76	1.1874	-4.067	8.69	2.2139	-12.625	11.24	16.67	0.0217
ADJUSTED:		13.00	1.1874	-4.067	8.69	R 2.0000	-11.123	11.12	17.37	0.0148
1	2	16.01	0.6546	-0.095	8.38	2.0837	-15.861	15.15	22.06	0.0057
ADJUSTED:		15.92	0.6546	-0.095	8.38	R 2.0000	-15.080	15.08	22.28	0.0053
1	3	20.59	0.8691	-5.036	15.88	2.0583	-20.541	19.91	26.08	0.0141
ADJUSTED:		21.33	0.8691	-5.036	15.88	R 2.0000	-19.869	19.87	26.23	0.0132
2	1	13.01	0.6067	-0.081	9.72	2.0289	-12.195	12.00	17.03	0.0397
ADJUSTED:		13.73	0.5956	1.161	8.92	R 2.0000	-11.985	11.98	17.59	0.0263
2	2	17.68	0.3958	1.775	12.22	1.8543	-14.709	16.02	22.60	0.0148
ADJUSTED:		17.68	0.4321	1.212	12.49	R 2.0000	-16.110	16.11	22.10	0.0189
2	3	22.81	0.2823	2.617	19.22	2.0583	-21.560	20.90	27.23	0.0120
ADJUSTED:		22.95	0.3529	1.256	18.78	R 2.0000	-20.857	20.86	26.85	0.0188
2	4	26.25	0.2142	3.903	22.47	2.0395	-25.981	25.44	32.75	0.0041
ADJUSTED:		27.19	0.2142	3.903	22.47	R 2.0000	-25.406	25.41	32.83	0.0040
2	5	31.67	0.1403	5.483	34.24	2.0194	-30.119	29.81	37.89	0.0015
ADJUSTED:		31.82	0.1753	4.631	27.54	R 2.0000	-29.791	29.79	37.73	0.0020
3	2	27.84	0.2923	1.353	26.39	1.5582	-15.340	20.32	26.37	0.0362
ADJUSTED:		27.83	0.2748	1.716	26.98	1.5582	-15.340	20.32	26.58	0.0320
3	3	31.00	0.2400	2.070	31.93	2.0289	-25.251	24.87	30.54	0.0236
ADJUSTED:		30.98	0.2970	0.735	29.77	R 2.0000	-24.850	24.85	30.05	0.0366
3	4	37.85	0.1951	2.946	37.98	1.8543	-26.641	28.89	35.66	0.0124
ADJUSTED:		37.85	0.2016	2.776	37.24	R 2.0000	-28.987	28.99	35.32	0.0135
3	5	37.33	0.1550	4.147	43.34	2.0328	-34.222	33.64	40.87	0.0046
ADJUSTED:		38.84	0.1938	3.064	37.29	R 2.0000	-33.611	33.61	40.61	0.0067
4	4	22.46	0.2432	4.264	22.03	2.1051	-20.822	19.69	26.38	0.0071
ADJUSTED:		22.46	0.2535	3.263	19.28	R 2.0000	-19.609	19.61	26.19	0.0105
4	5	25.54	0.1683	4.901	27.28	1.8714	-22.240	23.90	31.87	0.0032
ADJUSTED:		26.47	0.2144	3.976	22.81	R 2.0000	-24.030	24.03	31.30	0.0048

APD LINE PARAMETERS TEST 20

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	19.50	0.4809	-0.671	17.64	1.6785	-11.274	13.83	17.71	0.1019
ADJUSTED:		19.42	0.4008	0.543	18.01	1.6785	-11.274	13.83	18.50	0.0699
1	2	23.50	0.2284	2.712	29.48	2.0289	-18.221	17.94	23.25	0.0320
ADJUSTED:		27.03+	0.2355	1.513	26.47 R	2.0000	-17.923	17.92	22.67	0.0505
1	3	29.99	0.2172	2.654	33.21	1.5965	-18.070	23.19	30.05	0.0201
ADJUSTED:		30.96	0.2715	1.373	30.16	1.5965	-18.070	23.19	29.35	0.0323
2	1	12.57	0.6992	-0.879	9.55	2.0289	-11.190	11.01	15.51	0.0581
ADJUSTED:		13.01	0.5826	0.451	8.70 R	2.0000	-10.999	11.00	16.16	0.0377
2	2	17.55	0.4018	1.575	12.78	1.8543	-14.709	16.02	22.42	0.0173
ADJUSTED:		17.74	0.3349	2.617	12.72 R	2.0000	-16.103	16.10	22.49	0.0129
2	3	22.38	0.2218	2.232	20.46	2.0289	-21.233	20.91	27.02	0.0159
ADJUSTED:		23.48	0.3647	0.812	20.01 R	2.0000	-20.887	20.89	26.54	0.0254
2	4	26.49	0.1683	4.901	27.28	2.0194	-25.121	24.86	32.44	0.0030
ADJUSTED:		26.99	0.2104	3.967	22.90 R	2.0000	-24.843	24.84	32.20	0.0044
2	5	31.54	0.1386	5.479	35.37	2.0328	-30.197	29.68	37.67	0.0016
ADJUSTED:		32.07	0.1732	4.631	28.38 R	2.0000	-29.645	29.64	37.53	0.0022
3	2	21.00	0.2895	2.506	18.91	1.8543	-16.544	18.00	24.35	0.0181
ADJUSTED:		21.19	0.3619	1.178	18.28 R	2.0000	-18.001	18.08	23.51	0.0304
3	3	26.78	0.2176	3.397	26.25	2.0583	-23.598	22.88	29.33	0.0105
ADJUSTED:		26.76	0.2500	2.693	24.50 R	2.0000	-22.835	22.84	29.18	0.0135
3	4	30.35	0.1683	4.568	31.24	2.1511	-29.259	27.08	34.12	0.0039
ADJUSTED:		30.33	0.1972	3.885	27.66 R	2.0000	-26.943	26.94	34.20	0.0049
3	5	32.66	0.1354	5.268	40.63	2.0194	-32.118	31.79	39.69	0.0019
ADJUSTED:		41.17++	0.1354	5.268	40.63 R	2.0000	-31.772	31.77	39.73	0.0019
4	4	23.00	0.1370	4.883	20.56	2.0328	-20.135	19.78	27.11	0.0040
ADJUSTED:		23.00	0.1902	4.820	20.21 R	2.0000	-19.750	19.75	27.15	0.0041
4	5	27.31	0.1034	6.599	47.68	2.4683	-30.751	24.62	31.59	0.0013
ADJUSTED:		34.30++	0.1292	6.015	33.80	2.4683	-30.751	24.62	31.44	0.0017

APD LINE PARAMETERS TEST 21

FREQ	BW	VTRMS	MV	KV	VVRMS		MA	KA	VARMS	INTERSECT: DB	PROB
1	1	31.50	0.8220	-9.352	27.65		4.4506	-68.926	30.38	32.75	0.0762
ADJUSTED:		31.94	0.6850	-6.048	26.76		4.4506	-68.926	30.38	32.99	0.0540
1	2	33.12	0.3975	-1.507	28.61		2.6536	-42.364	31.57	36.22	0.0245
ADJUSTED:		33.35	0.3975	-1.507	28.61		2.6536	-42.364	31.57	36.22	0.0245
1	3	35.49	0.2750	0.998	32.18		2.5173	-42.360	33.34	38.67	0.0138
ADJUSTED:		35.51	0.3437	-0.743	31.46		2.5173	-42.360	33.34	38.29	0.0217
2	1	33.66	0.5178	-5.122	32.70		2.4719	-32.094	25.67	27.61	0.2032
ADJUSTED:		33.65	0.4826	-4.378	32.90		2.4719	-32.094	25.67	27.87	0.1797
2	2	40.02	0.3396	-1.728	37.86		2.1800	-30.206	27.57	30.95	0.1052
ADJUSTED:		39.97	0.2888	-0.484	39.72	R	2.0000	-27.567	27.57	31.65	0.0771
2	3	44.54	0.2545	0.132	43.71		3.2626	-52.587	31.75	35.05	0.0562
ADJUSTED:		44.53	0.2461	0.361	44.29		3.2626	-52.587	31.75	35.11	0.0529
2	4	48.46	0.1807	2.127	53.17		5.2765	-97.360	36.39	39.05	0.0253
ADJUSTED:		48.41	0.2189	0.961	48.16		5.2765	-97.360	36.39	38.88	0.0360
2	5	52.81	0.1479	3.172	61.01		4.8838	-100.801	40.76	43.91	0.0125
ADJUSTED:		53.13	0.1849	1.958	52.92		4.8838	-100.801	40.76	43.74	0.0187
3	2	21.94	0.2982	2.435	19.30		2.0289	-15.208	14.97	20.29	0.0317
ADJUSTED:		21.94	0.2496	3.144	20.97	R	2.0000	-14.953	14.95	20.68	0.0238
3	3	26.58	0.2211	3.154	27.52		2.1197	-21.062	19.77	25.51	0.0191
ADJUSTED:		26.56	0.2532	2.475	25.56	R	2.0000	-19.704	19.70	25.39	0.0245
3	4	30.68	0.1868	3.593	34.45		1.8543	-22.052	23.94	30.76	0.0119
ADJUSTED:		31.10	0.2335	2.481	30.15	R	2.0000	-24.038	24.04	30.02	0.0189
3	5	31.10	0.1473	4.630	41.69		2.0194	-29.119	28.82	36.05	0.0047
ADJUSTED:		35.69+	0.1841	3.671	34.70	R	2.0000	-28.805	28.80	35.77	0.0069
4	4	21.36	0.1550	5.912	20.57		2.0819	-20.261	19.39	27.17	0.0018
ADJUSTED:		21.35	0.1770	5.496	17.09	R	2.0000	-19.306	19.31	27.21	0.0021
4	5	24.96	0.1491	5.879	23.77		2.0194	-24.121	23.87	32.08	0.0012
ADJUSTED:		24.95	0.1849	5.140	18.47	R	2.0000	-23.850	23.85	31.94	0.0016

APD LINE PARAMETERS TEST 22

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	24.56	0.6178	-4.028	22.15	2.6912	-30.987	22.65	26.01	0.0809
ADJUSTED:		25.20	0.5148	-2.219	21.68	2.6912	-30.987	22.65	26.44	0.0564
1	2	27.83	0.4221	-1.570	26.32	2.9286	-36.393	24.42	27.79	0.0680
ADJUSTED:		28.48	0.4221	-1.570	26.32	2.9286	-36.393	24.42	27.79	0.0680
1	3	32.98	0.3298	-0.202	30.32	2.6316	-37.827	28.39	32.69	0.0368
ADJUSTED:		32.98	0.2919	0.674	31.12	2.6316	-37.827	28.39	32.91	0.0293
2	1	24.30	0.5694	-3.213	22.02	2.4719	-25.977	20.72	23.93	0.1012
ADJUSTED:		24.34	0.4745	-1.574	21.87	2.4719	-25.977	20.72	24.43	0.0711
2	2	28.00	0.4367	-1.987	26.85	2.2303	-27.075	24.10	27.98	0.0755
ADJUSTED:		28.69	0.4367	-1.987	26.85 R	2.0000	-24.066	24.07	28.25	0.0729
2	3	33.90	0.2678	1.133	32.74	3.2626	-50.972	30.76	34.80	0.0225
ADJUSTED:		34.13	0.3347	-0.513	31.44	3.2626	-50.972	30.76	34.47	0.0350
2	4	38.56	0.2219	2.009	37.62	3.4559	-64.330	36.73	41.03	0.0108
ADJUSTED:		39.12	0.2773	0.486	35.38	3.4559	-64.330	36.73	40.78	0.0164
2	5	42.49	0.1403	4.372	50.08	3.4341	-66.435	38.19	42.99	0.0042
ADJUSTED:		43.73	0.1753	3.337	42.30	3.4341	-66.435	38.19	42.82	0.0060
3	2	23.48	0.3476	0.911	21.35	1.7627	-15.719	18.11	23.50	0.0425
ADJUSTED:		23.47	0.3117	1.569	21.95 R	2.0000	-18.171	18.17	23.38	0.0361
3	3	32.76	0.2115	3.170	30.13	1.8543	-21.134	22.95	29.59	0.0141
ADJUSTED:		32.75	0.1921	3.609	32.25 R	2.0000	-23.042	23.04	29.48	0.0122
3	4	31.00	0.2779	0.547	34.82	2.2158	-30.849	27.68	32.40	0.0408
ADJUSTED:		31.32+	0.3474	-1.157	33.29 R	2.0000	-27.598	27.60	32.00	0.0637
3	5	36.67	0.2403	2.753	37.97	2.0583	-32.768	31.79	38.23	0.0106
ADJUSTED:		36.66	0.2432	1.603	34.97 R	2.0000	-31.745	31.75	37.96	0.0152
4	4	25.24	0.3144	0.891	25.89	2.0156	-20.402	19.91	24.60	0.0503
ADJUSTED:		26.13	0.3930	-0.683	24.96 R	2.0000	-19.895	19.89	23.99	0.0807
4	5	32.49	0.1837	3.627	35.34	2.2323	-28.353	24.64	30.48	0.0124
ADJUSTED:		32.47	0.2167	2.830	31.72 R	2.0000	-24.448	24.45	30.59	0.0163

APD LINE PARAMETERS TEST 23

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	19.66	0.6068	-2.542	17.83	4.9947	-42.622	16.55	18.27	0.1360
ADJUSTED:		20.19	0.5056	-1.065	17.72	4.9947	-42.622	16.55	18.52	0.1003
1	2	30.48	0.4178	-0.970	23.88	3.3771	-50.262	29.27	33.31	0.0189
ADJUSTED:		30.43	0.4720	-2.110	24.32	3.3771	-50.262	29.27	33.15	0.0241
1	3	32.17	0.2379	2.315	30.41	2.5995	-38.902	29.59	34.91	0.0119
ADJUSTED:		32.19	0.2974	0.881	28.72	2.5995	-38.902	29.59	34.56	0.0183
2	1	24.37	0.5288	-2.038	20.11	3.7783	-37.109	19.13	21.59	0.0975
ADJUSTED:		22.97	0.6609	-4.211	20.67	3.7783	-37.109	19.13	21.11	0.1511
2	2	31.94	0.4069	-0.945	24.99	2.2159	-28.655	25.70	30.62	0.0345
ADJUSTED:		28.54-	0.5375	-3.053	25.45 R	2.0000	-25.607	25.61	30.22	0.0553
2	3	31.93	0.2300	2.432	31.51	2.9170	-42.552	28.75	33.48	0.0143
ADJUSTED:		32.07	0.2875	1.049	29.35	2.9170	-42.552	28.75	33.16	0.0220
2	4	35.13	0.1841	3.337	38.32	2.9692	-49.219	32.71	37.74	0.0082
ADJUSTED:		36.54	0.2301	2.114	34.22	2.9692	-49.219	32.71	37.48	0.0124
2	5	NO DATA ON FILE								
3	2	30.50	0.2586	2.464	24.54	1.7627	-15.719	18.11	24.18	0.0267
ADJUSTED:		28.04	0.2155	3.318	27.56 R	2.0000	-18.211	18.21	24.13	0.0201
3	3	29.67	0.1808	3.859	34.00	2.0583	-23.598	22.88	29.25	0.0115
ADJUSTED:		30.21	0.2260	2.804	29.33 R	2.0000	-22.836	22.84	28.91	0.0175
3	4	35.92	0.1339	5.000	45.74	2.0177	-27.381	27.12	34.38	0.0046
ADJUSTED:		37.32	0.1674	4.132	36.89 R	2.0000	-27.108	27.11	34.09	0.0068
3	5	42.82	0.1215	5.186	53.52	2.0194	-32.118	31.79	39.31	0.0033
ADJUSTED:		43.19	0.1518	4.330	42.86 R	2.0000	-31.773	31.77	39.07	0.0047
4	4	21.53	0.1339	6.325	25.94	2.2242	-21.717	19.36	26.83	0.0015
ADJUSTED:		21.76	0.1674	5.683	18.35 R	2.0000	-19.119	19.12	27.07	0.0020
4	5	26.14	0.1215	6.388	33.72	2.0194	-24.121	23.87	32.15	0.0011
ADJUSTED:		27.10	0.1518	5.737	24.32 R	2.0000	-23.850	23.85	32.02	0.0014

APD LINE PARAMETERS   TEST 24

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT: DB	PROB
1	1	33.32	0.9171	-11.417	28.66	5.2765	-86.912	32.43	34.64	0.0611
ADJUSTED:		33.95	0.9171	-11.417	28.66	5.2765	-86.912	32.43	34.64	0.0611
1	2	34.59	0.4373	-3.530	28.98	3.7884	-64.037	33.29	36.66	0.0312
ADJUSTED:		34.59	0.4448	-2.568	28.71	3.7884	-64.037	33.29	36.77	0.0263
1	3	38.25	0.2231	0.402	32.74	2.5173	-44.852	35.32	40.69	0.0132
ADJUSTED:		37.78	0.2443	1.669	34.14	2.5173	-44.852	35.32	40.93	0.0096
2	1	32.79	0.5684	-5.810	31.21	4.9946	-72.290	28.43	30.04	0.1535
ADJUSTED:		33.05	0.5584	-5.810	31.21	4.9946	-72.290	28.43	30.04	0.1535
2	2	36.79	0.3401	-1.196	34.64	2.6316	-41.735	31.36	35.38	0.0481
ADJUSTED:		36.78	0.3061	-0.354	35.31	2.6316	-41.735	31.36	35.59	0.0395
2	3	42.94	0.2265	1.320	42.28	3.2728	-56.970	34.33	38.27	0.0253
ADJUSTED:		42.93	0.2265	1.320	42.28	3.2728	-56.970	34.33	38.27	0.0253
2	4	47.17	0.1805	2.348	50.87	2.8021	-56.254	39.75	44.71	0.0129
ADJUSTED:		47.16	0.2219	1.046	46.29	2.8021	-56.254	39.75	44.42	0.0191
2	5	52.08	0.1455	3.482	53.62	3.2672	-70.436	42.64	47.36	0.0072
ADJUSTED:		52.07	0.1775	2.424	51.54	3.2672	-70.436	42.64	47.16	0.0102
3	2	24.43	0.2849	1.999	23.17	1.7627	-16.591	19.10	25.16	0.0269
ADJUSTED:		24.47	0.2935	1.830	22.94 R	2.0000	-19.201	19.20	24.65	0.0300
3	3	29.33	0.2111	3.180	30.16	2.0583	-24.616	23.87	30.10	0.0133
ADJUSTED:		29.30	0.2470	2.360	27.86 R	2.0000	-23.829	23.83	29.89	0.0178
3	4	36.17	0.1870	3.404	36.41	2.0194	-28.120	27.83	34.41	0.0101
ADJUSTED:		36.17	0.1943	3.217	35.48 R	2.0000	-27.818	27.82	34.38	0.0108
3	5	37.88	0.1253	5.190	49.87	2.0194	-33.118	32.78	40.45	0.0027
ADJUSTED:		40.92+	0.1567	4.317	40.20 R	2.0000	-32.763	32.76	40.23	0.0038
4	4	22.99	0.1659	5.150	25.31	2.0328	-20.135	19.78	27.09	0.0041
ADJUSTED:		23.12	0.2074	4.307	20.44 R	2.0000	-19.750	19.75	26.84	0.0060
4	5	29.90	0.2181	3.560	24.62	2.2242	-27.222	24.31	30.69	0.0074
ADJUSTED:		29.63	0.1818	4.349	28.19 R	2.0003	-24.130	24.13	31.33	0.0053

APD LINE PARAMETERS TEST 30

FREQ	BW	VTRMS	AV	KV	VVRMS	AA	KA	VARMS	INTERSECT: DB	PROB
1	1	NO DATA ON FILE								
1	2	41.14	3.8258	-77.935	40.22	3.8258	-77.935	40.22	44.21	0.0100
ADJUSTED:		40.22	3.8258	-77.935	40.22	3.8258	-77.935	40.22	44.21	0.0100
1	3	NO DATA ON FILE								
2	1	NO DATA ON FILE								
2	2	NO DATA ON FILE								
2	3	30.19 *	5.0865	-79.593	30.78	5.0865	-79.593	30.78	33.90	0.0100
ADJUSTED:		30.78	5.0865	-79.593	30.78	5.0865	-79.593	30.78	33.90	0.0100
2	4	36.99 *	4.2258	-82.637	38.58	4.2258	-82.637	38.58	42.25	0.0100
ADJUSTED:		38.58	4.2258	-82.637	38.58	4.2258	-82.637	38.58	42.25	0.0100
2	5	36.39 *	4.2550	-83.032	38.50	4.2550	-83.032	38.50	42.15	0.0100
ADJUSTED:		38.50	4.2550	-83.032	38.50	4.2550	-83.032	38.50	42.15	0.0100
3	2	NO DATA ON FILE								
3	3	19.80	1.9871	-18.784	18.92	1.9871	-18.784	18.92	25.58	0.0100
ADJUSTED:		21.93	1.9871	-18.784	18.92 R	2.0000	-18.928	18.93	22.24	0.1170
3	4	NO DATA ON FILE								
3	5	29.01	2.2235	-31.963	28.58	2.2235	-31.963	28.58	34.72	0.0100
ADJUSTED:		31.51	2.2235	-31.963	28.58 R	2.0000	-28.417	28.42	31.73	0.1170
4	4	NO DATA ON FILE								
4	5	24.34	2.1467	-25.585	23.72	2.1467	-25.585	23.72	30.02	0.0100
ADJUSTED:		26.67	2.1467	-25.585	23.72 R	2.0000	-23.610	23.61	26.93	0.1170

APD LINE PARAMETERS TEST 29

FREQ	BW	VTRMS	MV	KV	VVRMS	MA	KA	VARMS	INTERSECT, DB	PROB
1	1	25.16	0.4612	-0.742	19.27	2.5173	-31.145	24.43	29.57	0.0174
ADJUSTED:		25.59	0.4612	-0.742	19.27	2.5173	-31.145	24.43	29.57	0.0174
1	2	28.05	0.3134	1.364	23.02	2.3181	-30.562	26.14	31.85	0.0133
ADJUSTED:		28.04	0.2625	2.448	23.90 R	2.0000	-25.933	25.93	32.67	0.0090
1	3	32.65	0.2334	2.371	31.10	2.5173	-37.375	29.38	34.81	0.0123
ADJUSTED:		32.63	0.2629	1.657	29.85	2.5173	-37.375	29.38	34.63	0.0154
2	1	19.73	0.4060	1.065	15.00	2.2205	-19.488	17.38	22.65	0.0251
ADJUSTED:		19.58	0.5075	-0.591	15.74 R	2.0000	-17.271	17.27	22.35	0.0399
2	2	26.08 *	0.3416	1.029	21.37	4.3647	-60.018	26.97	30.35	0.0153
ADJUSTED:		28.03	0.3416	1.029	21.37	4.3647	-60.018	26.97	30.35	0.0153
2	3	30.54	0.2630	2.035	26.95	3.0280	-44.527	28.96	33.68	0.0119
ADJUSTED:		30.75	0.3287	0.531	26.03	3.0280	-44.527	28.96	33.38	0.0184
2	4	32.24	0.1571	4.679	35.36	2.5757	-40.978	31.48	37.75	0.0030
ADJUSTED:		36.85+	0.1571	4.679	35.36	2.5757	-40.978	31.48	37.75	0.0030
2	5	35.88 *	0.1491	4.624	40.60	2.9973	-55.015	36.27	41.88	0.0026
ADJUSTED:		39.26+	0.1720	4.000	36.23	2.9973	-55.015	36.27	41.78	0.0032
3	2	23.15	0.2396	3.072	23.66	1.8543	-15.626	17.01	23.16	0.0214
ADJUSTED:		23.12	0.2823	2.243	21.88 R	2.0000	-17.084	17.08	22.50	0.0307
3	3	29.67	0.1780	4.015	33.40	2.1197	-23.169	21.75	27.99	0.0114
ADJUSTED:		29.66	0.2173	3.118	28.91 R	2.0000	-21.669	21.67	27.81	0.0164
3	4	31.80	0.1215	5.667	45.60	2.2242	-29.424	26.29	33.38	0.0028
ADJUSTED:		35.68+	0.1518	4.913	35.18 R	2.0000	-26.070	26.07	33.53	0.0038
3	5	31.86	0.0982	6.230	61.79	2.1928	-33.924	30.79	38.34	0.0015
ADJUSTED:		46.21++	0.1228	5.566	46.09 R	2.0000	-30.584	30.58	38.51	0.0020
4	4	21.50	0.1016	6.825	45.44	2.2242	-22.818	20.35	27.93	0.0013
ADJUSTED:		31.42++	0.1270	6.292	31.09 R	2.0000	-20.103	20.10	28.18	0.0016
4	5	31.00	0.1294	6.220	30.45	2.1928	-29.582	26.83	34.70	0.0009
ADJUSTED:		31.00	0.1337	6.127	29.04 R	2.0000	-26.608	26.61	35.08	0.0009

3.5 DATA PLOTS OF APD STRAIGHT-LINE APPROXIMATIONS FOR SINGLE AND MULTIPLE VEHICLES

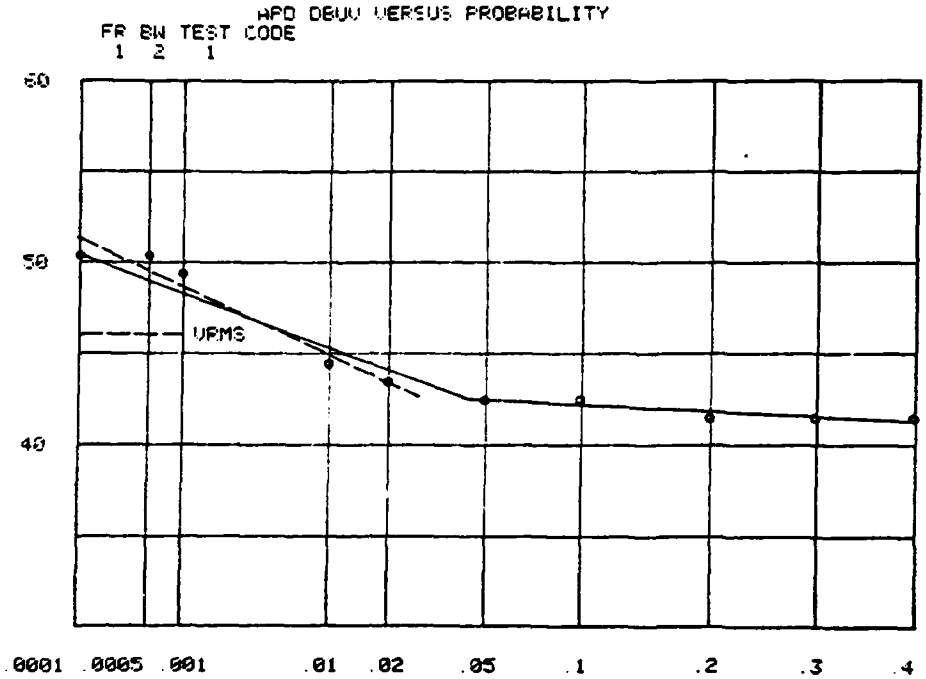
This paragraph presents the data plots of the APD straight-line approximations for single and multiple-vehicles. These plots were constructed by using the data listed in paragraph 3.7.6. These plots show only those cases where the predicted and measured V_{rms} differed by more than 3 dB. The plots show values of voltage threshold in dB(μV) versus probability for various frequency-bandwidth combinations. The codes employed on each plot for frequency and bandwidth are as follows:

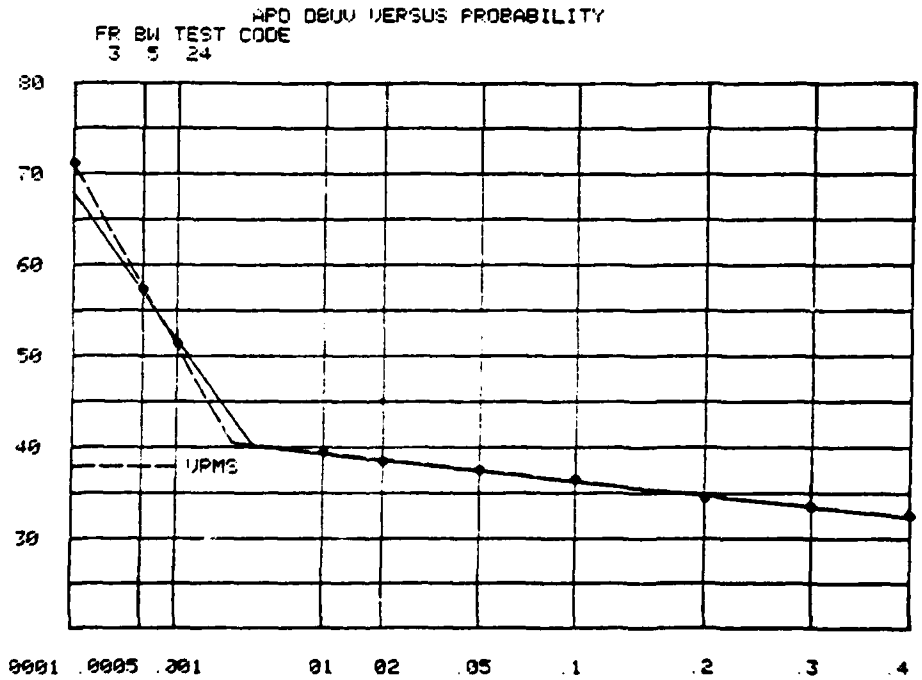
Frequency

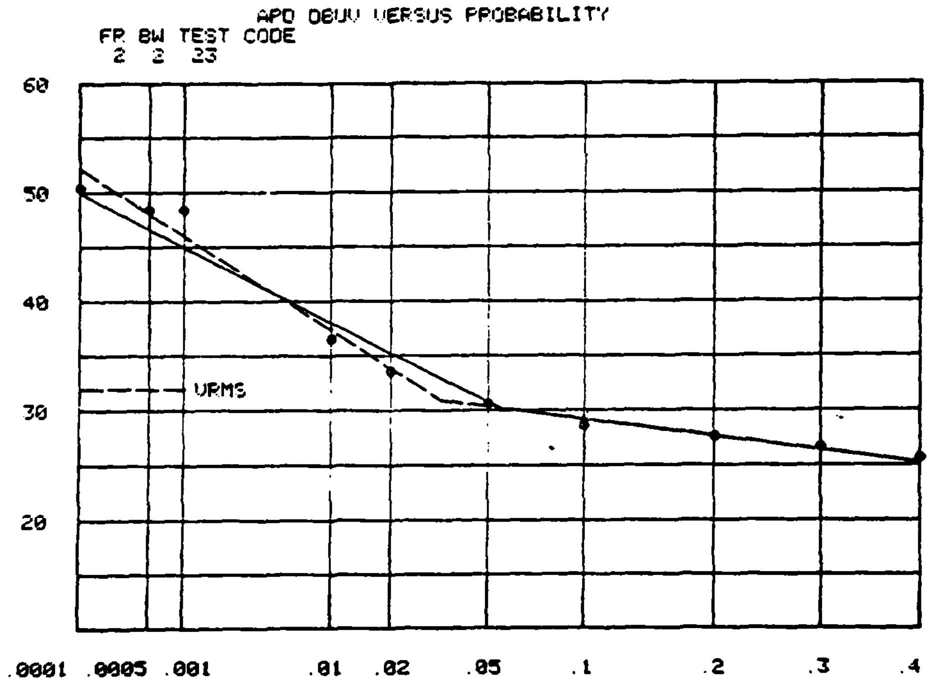
Code	Value
1	23 MHz
2	75 MHz
3	300 MHz
4	900 MHz

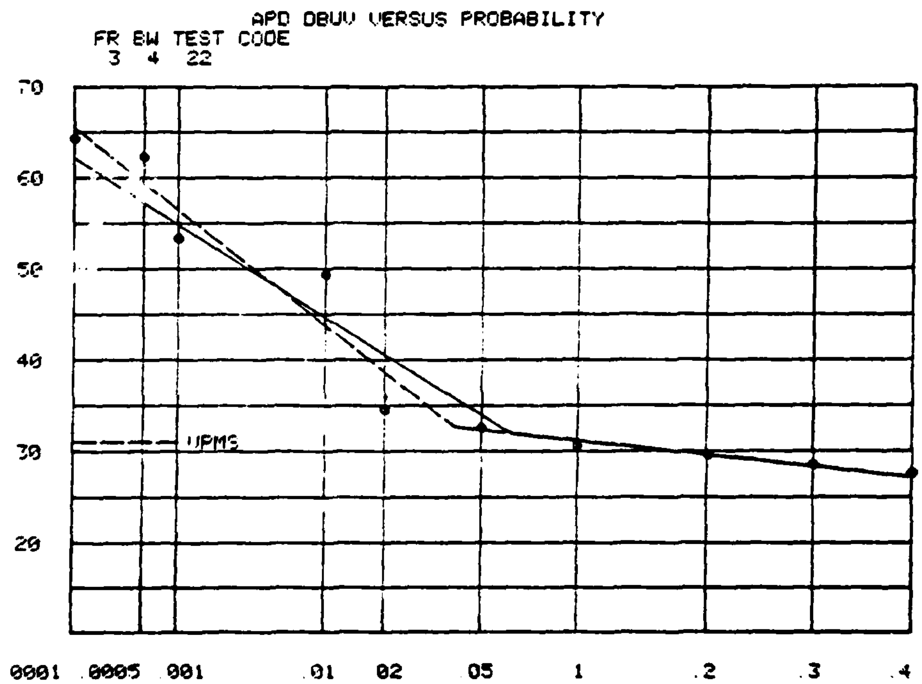
Bandwidth

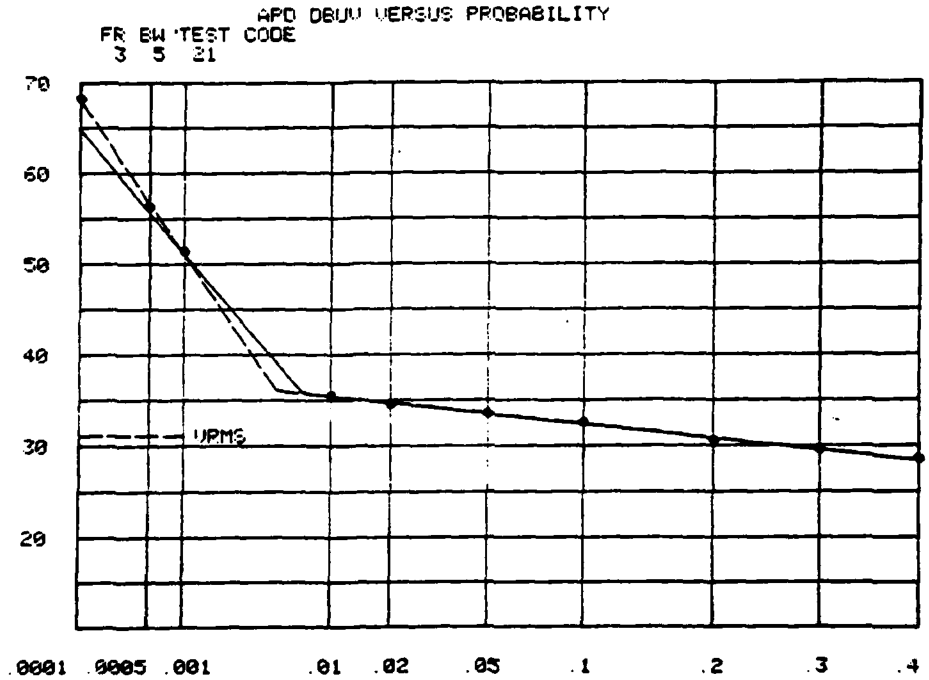
Code	Value
1	3 KHz
2	10 KHz
3	30 KHz
4	100 KHz
5	300 KHz

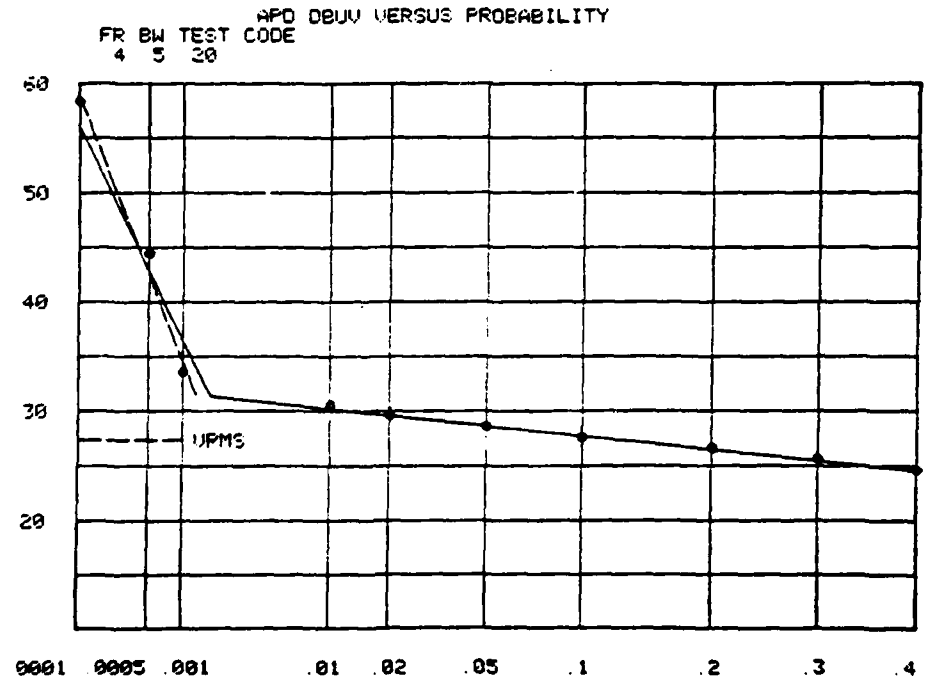

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 2 1
60
50
40
VRMS
.0001 .0005 .001
.01 .02 .05 .1 .2 .3 .4

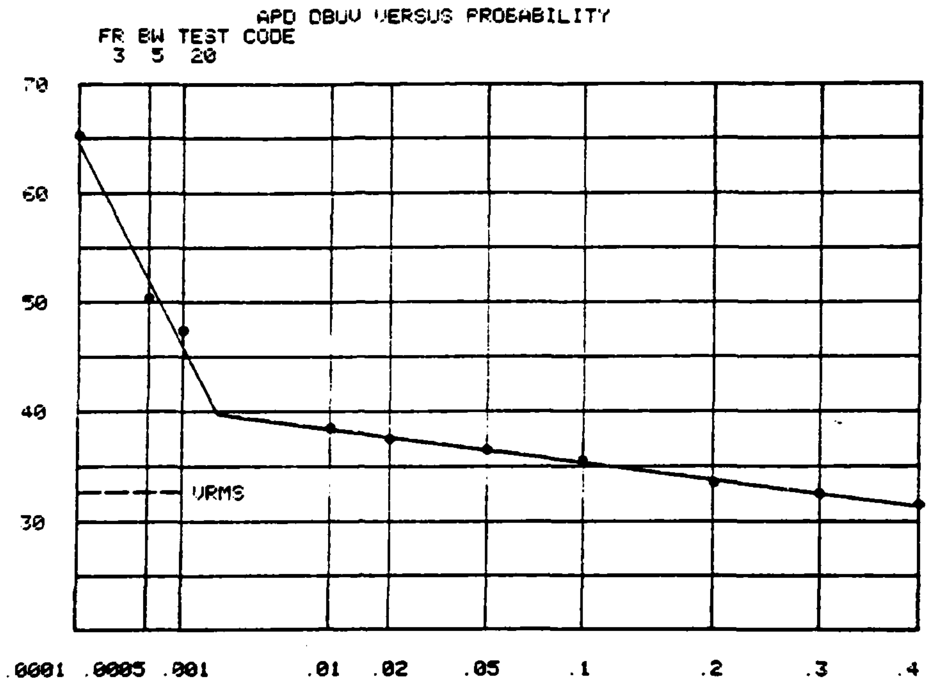

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 24
80
70
60
50
40
30
VRMS
0001 .0005 .001
01 02 .05 .1 .2 .3 .4

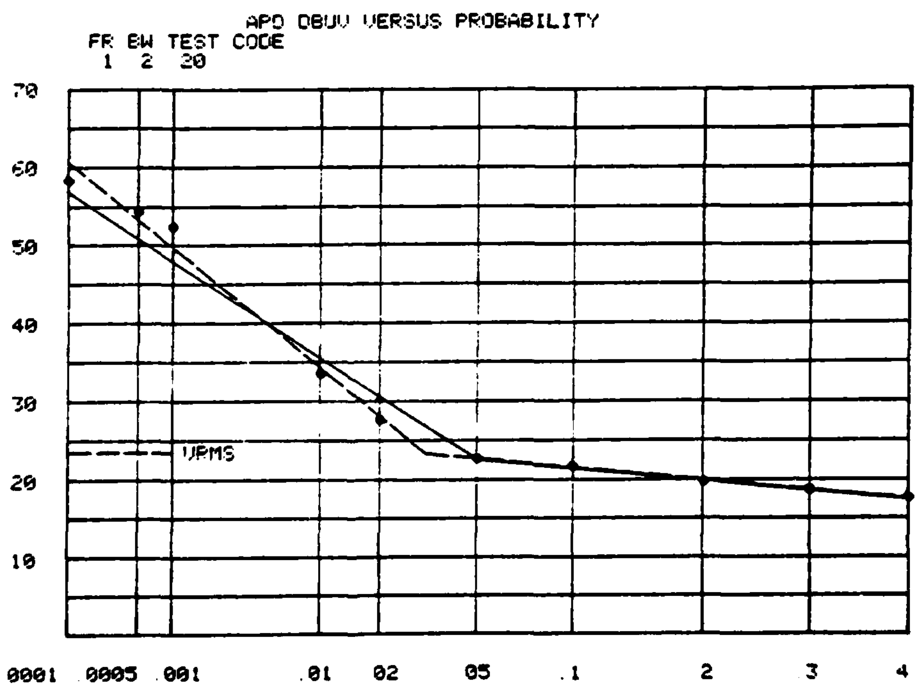

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 2 23
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

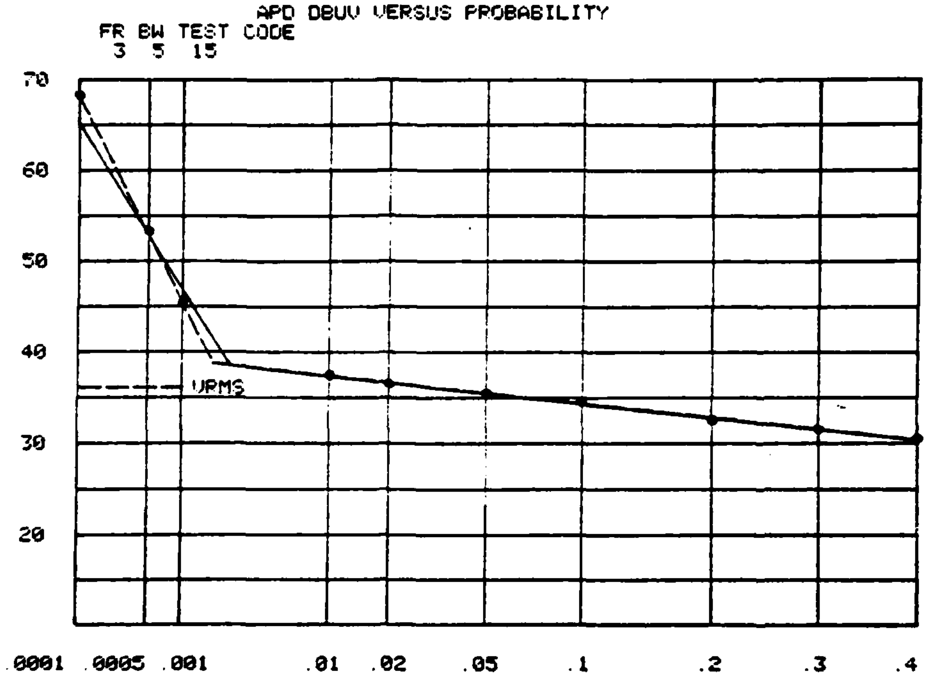

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 4 22
70
60
50
40
30
20
VRMS
0001 .0005 001 .01 02 05 1 .2 .3 .4

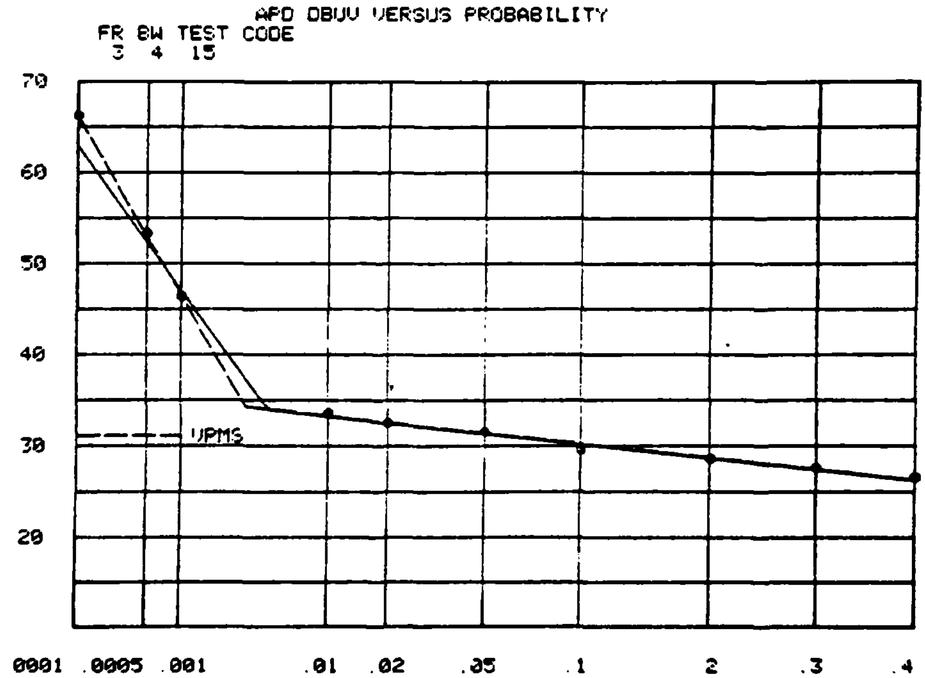

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 21
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

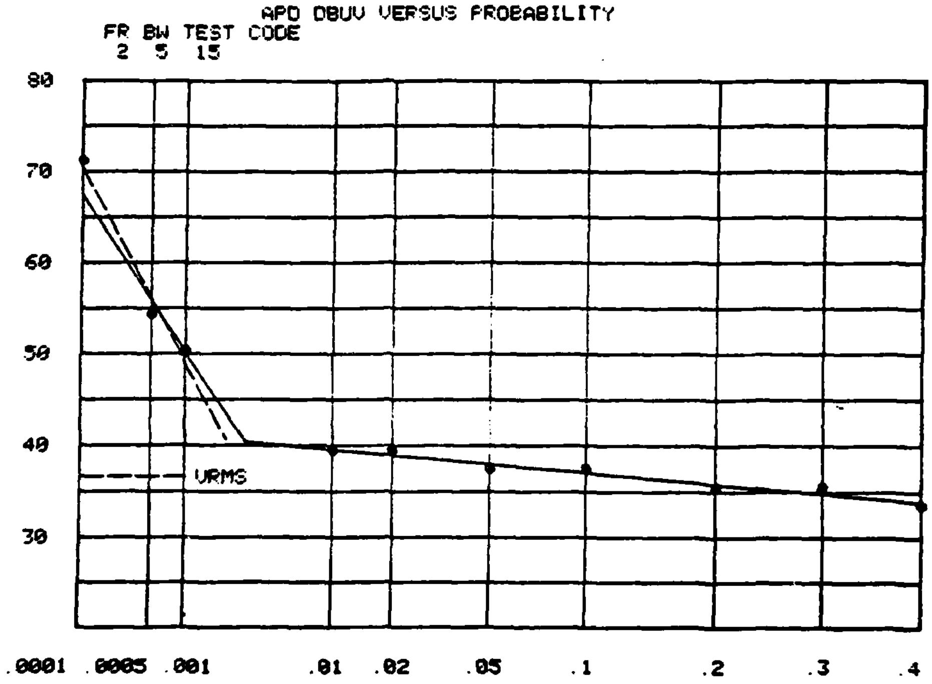

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 20
60
50
40
30
20
VRMS
0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

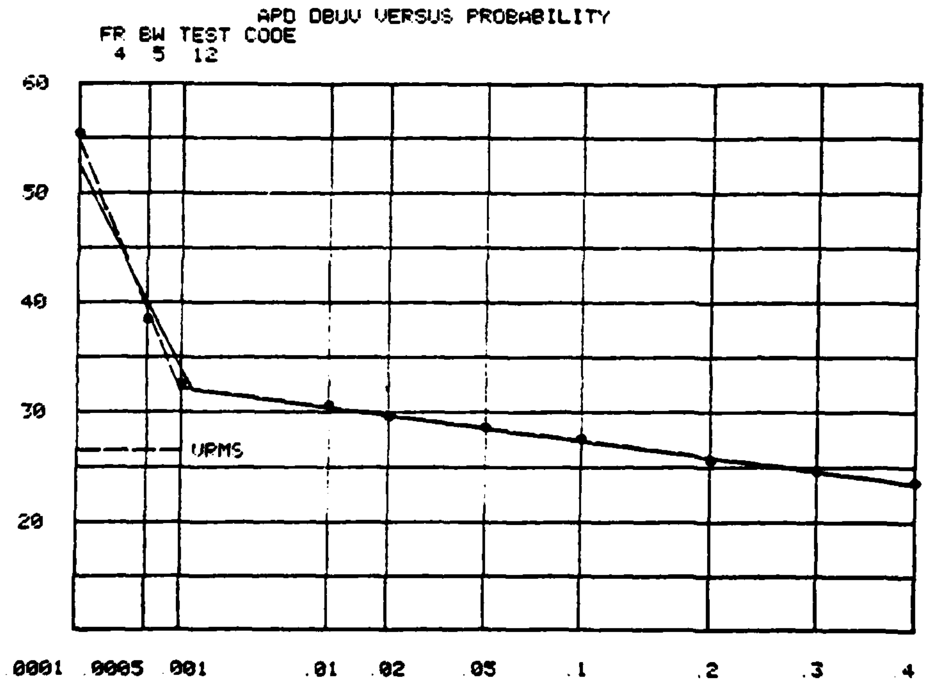

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 20
70
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

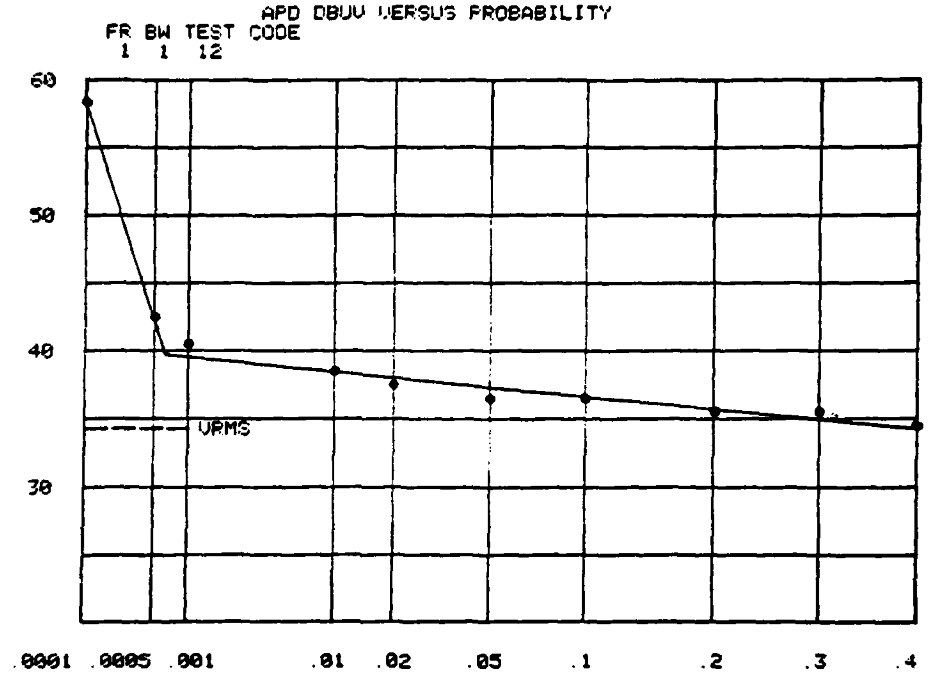

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 2 20
70
60
50
40
30
20
10
VRMS
0001 0005 .001 .01 02 05 .1 2 3 4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 15
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

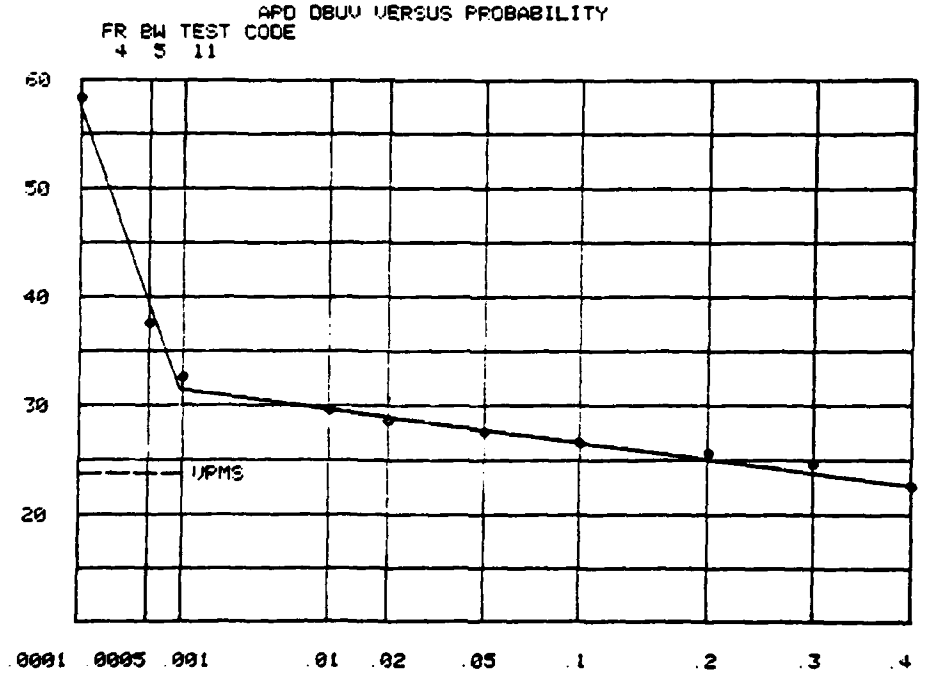

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 4 15
70
60
50
40
30
20
VRMS
0001 .0005 .001 .01 .02 .05 .1 2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 5 15
80
70
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

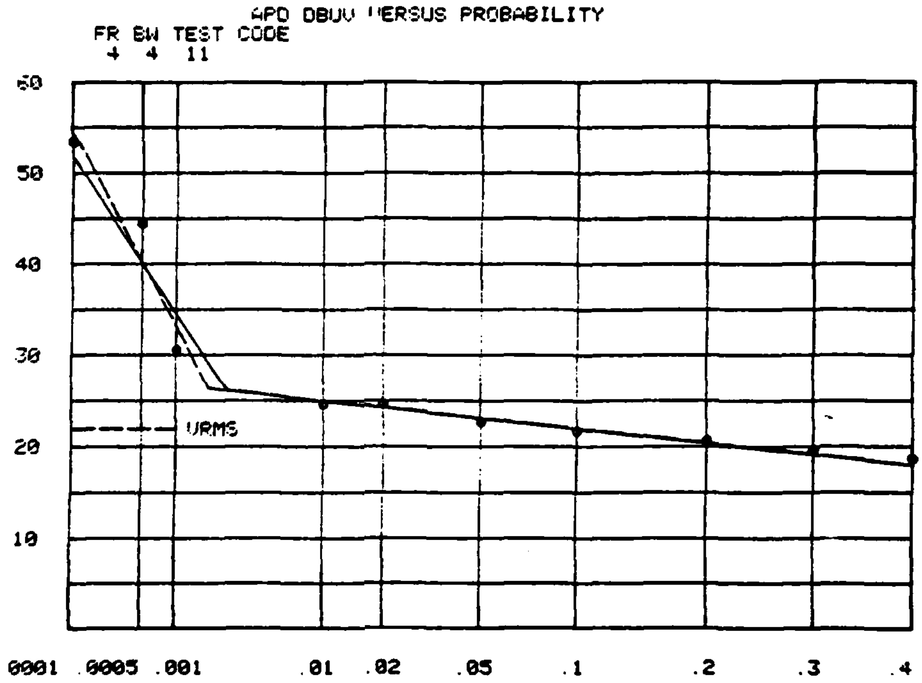

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 12
60
50
40
30
20
VRMS
0001 .0005 001 .01 .02 .05 .1 .2 .3 .4

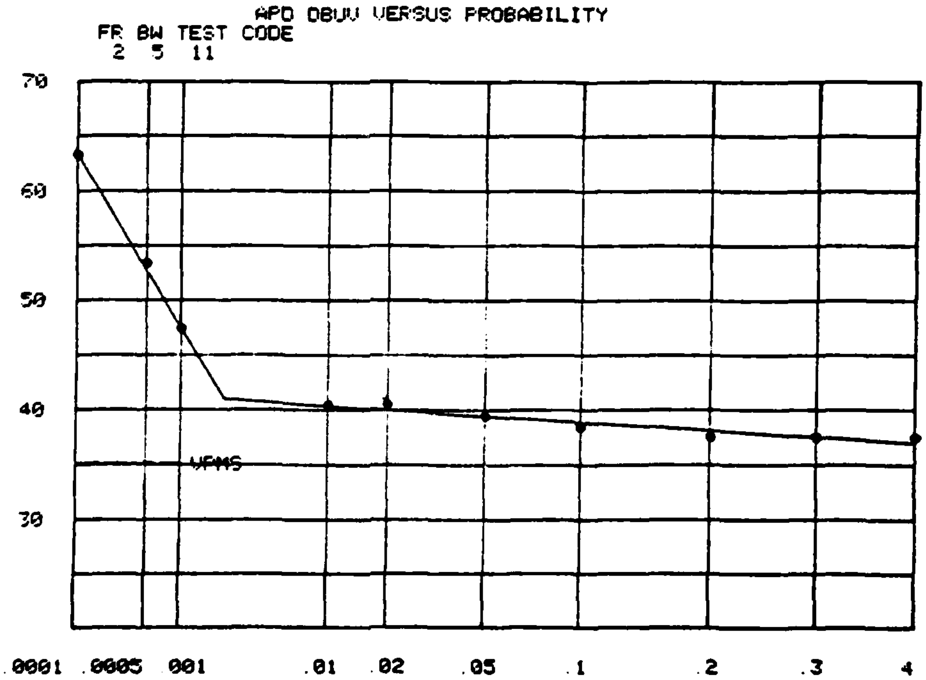


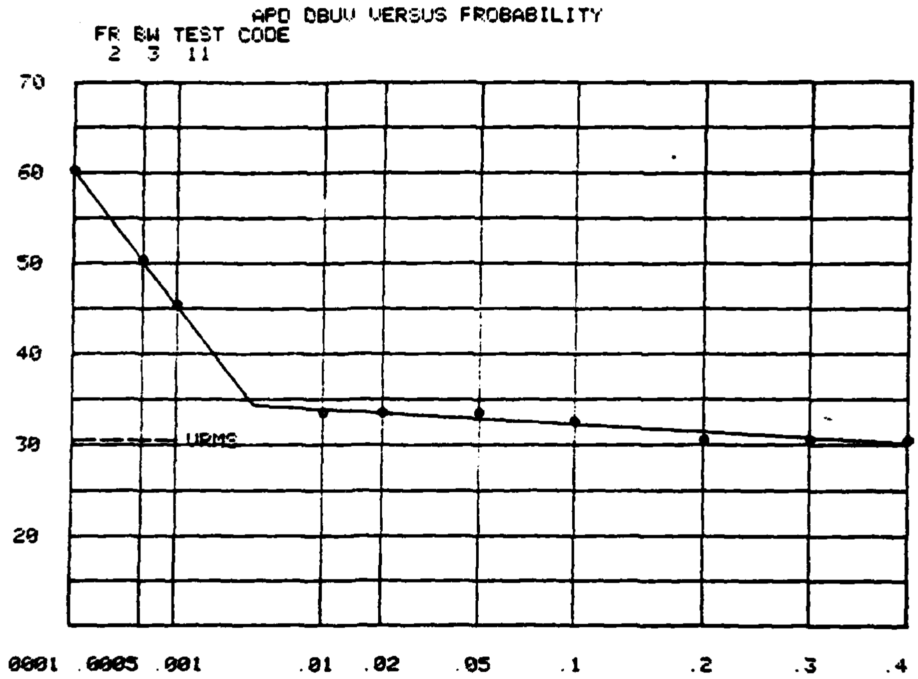
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 1 12
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

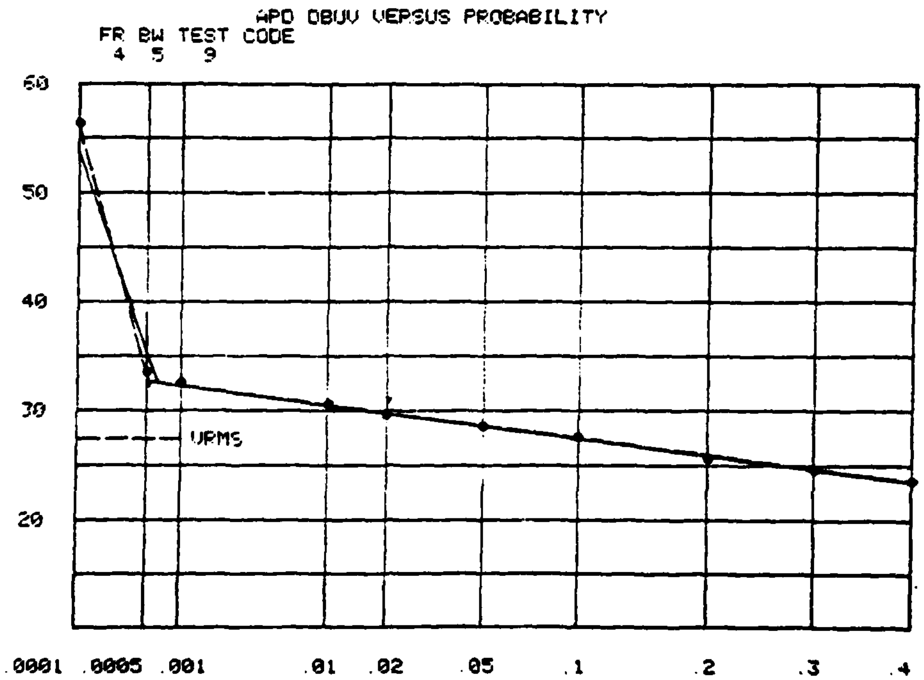


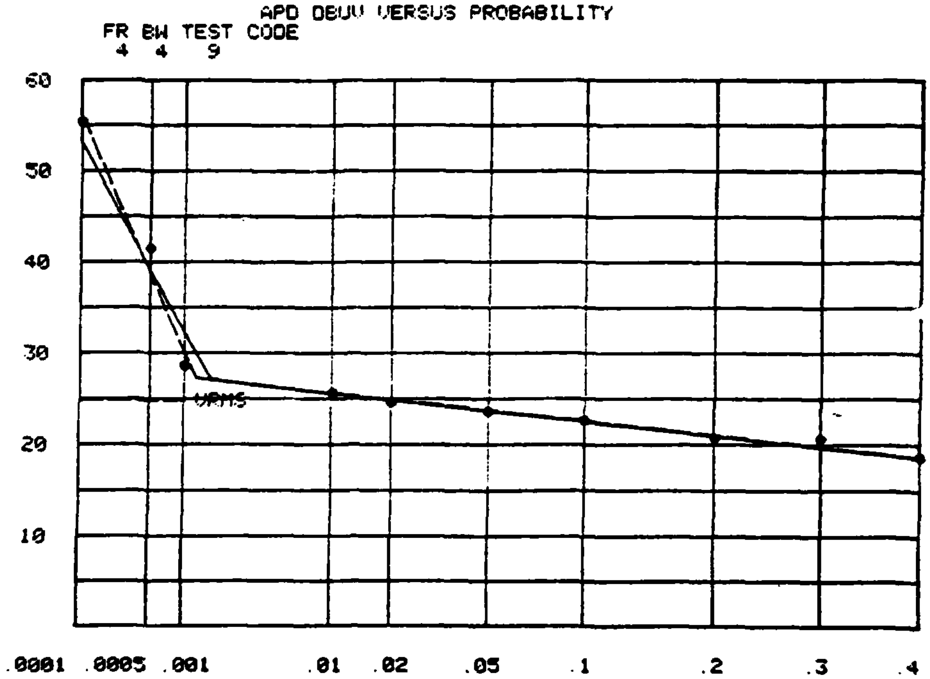
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 11
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 4 11
60
50
40
30
20
10
VRMS
0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

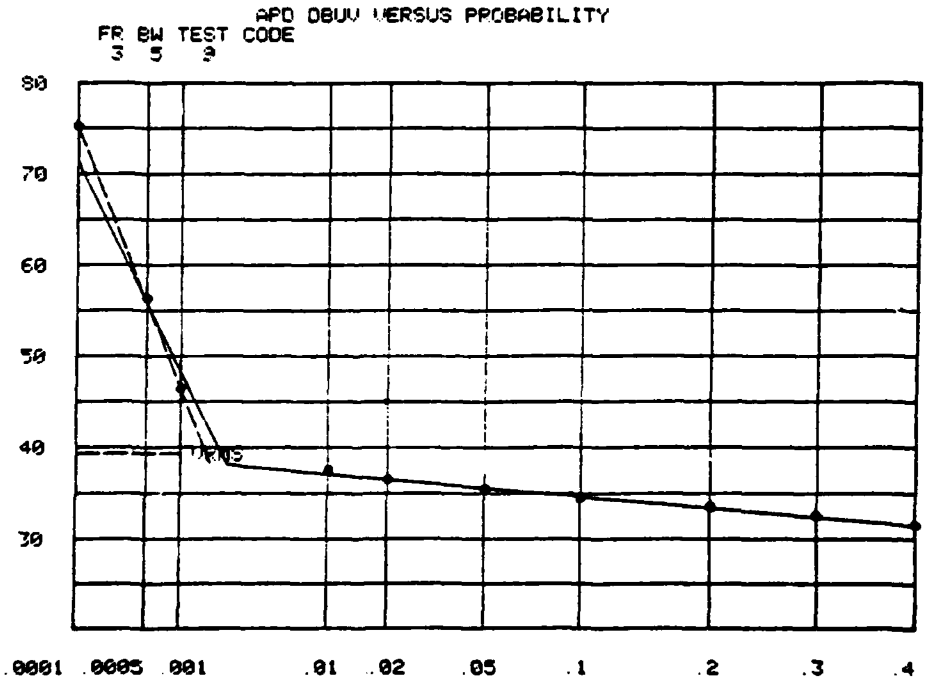

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 5 11
70
60
50
40
30
VRMS
.0001 .0005 001 .01 .02 .05 .1 .2 .3 4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 3 11
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

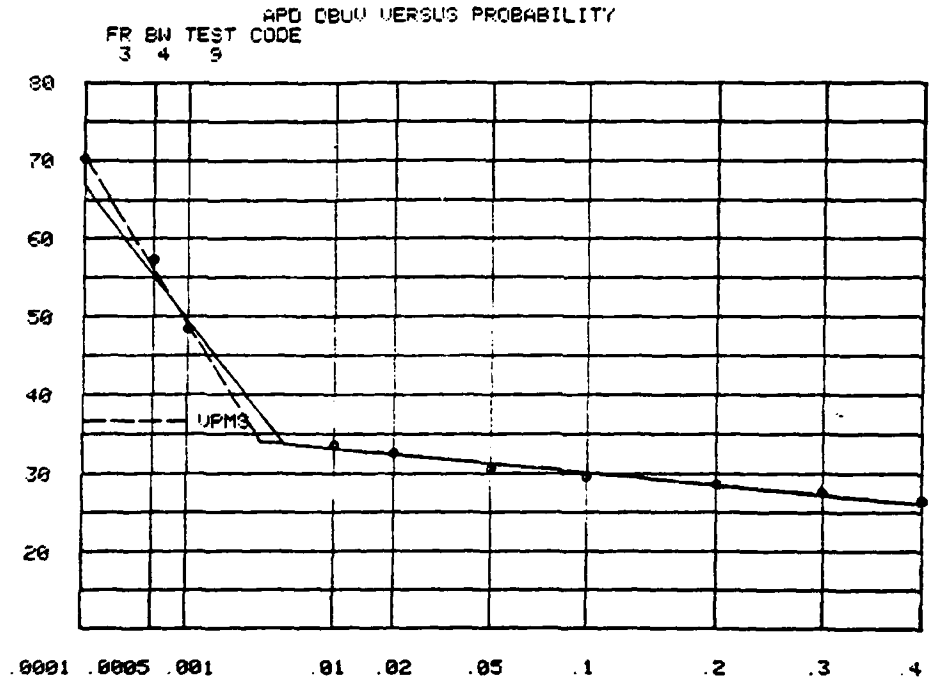

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 9
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

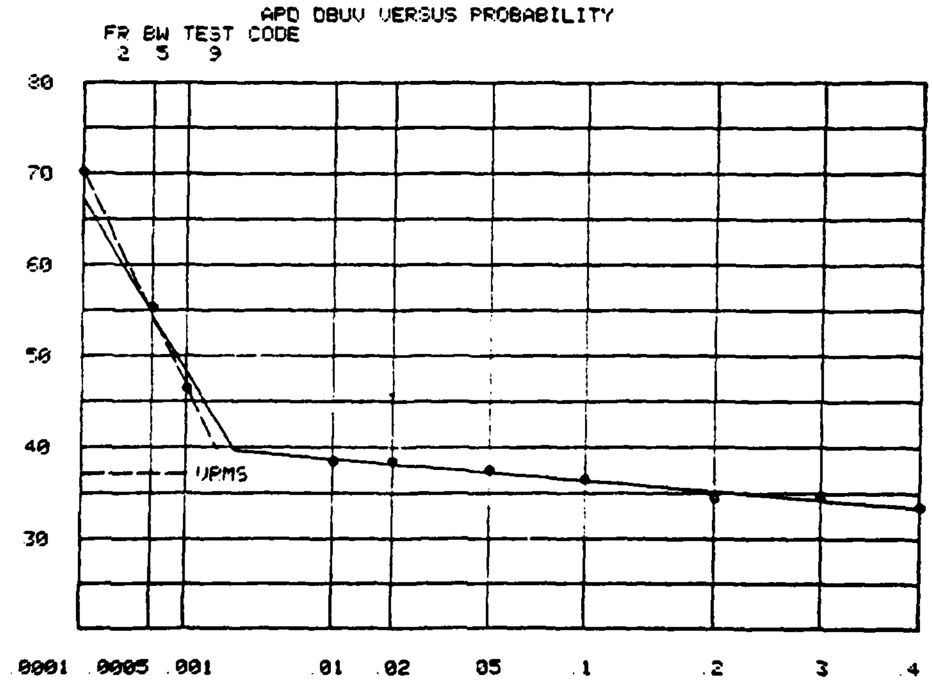


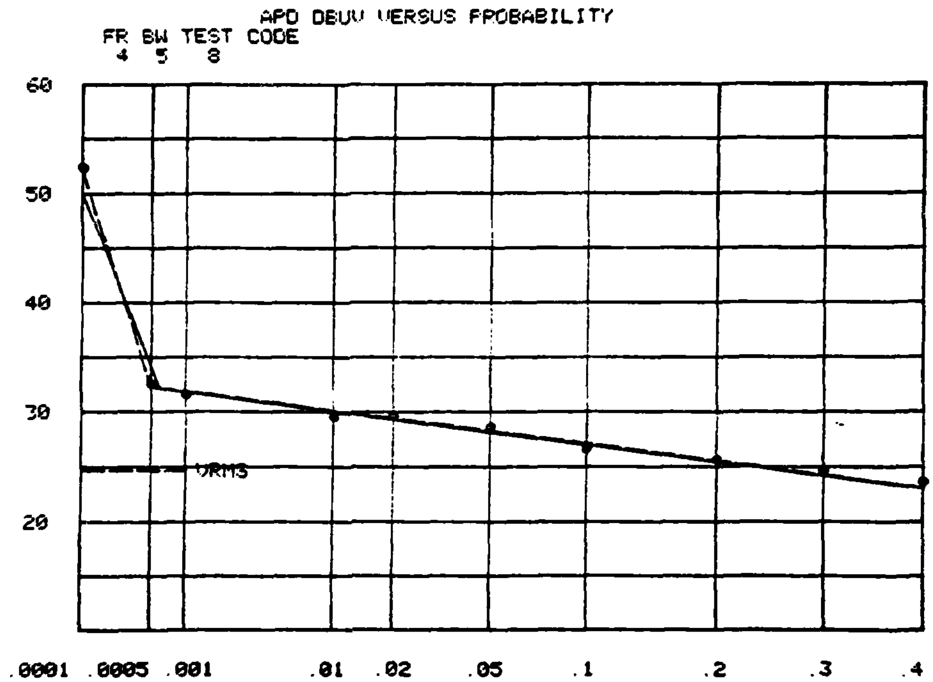
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 4 9
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

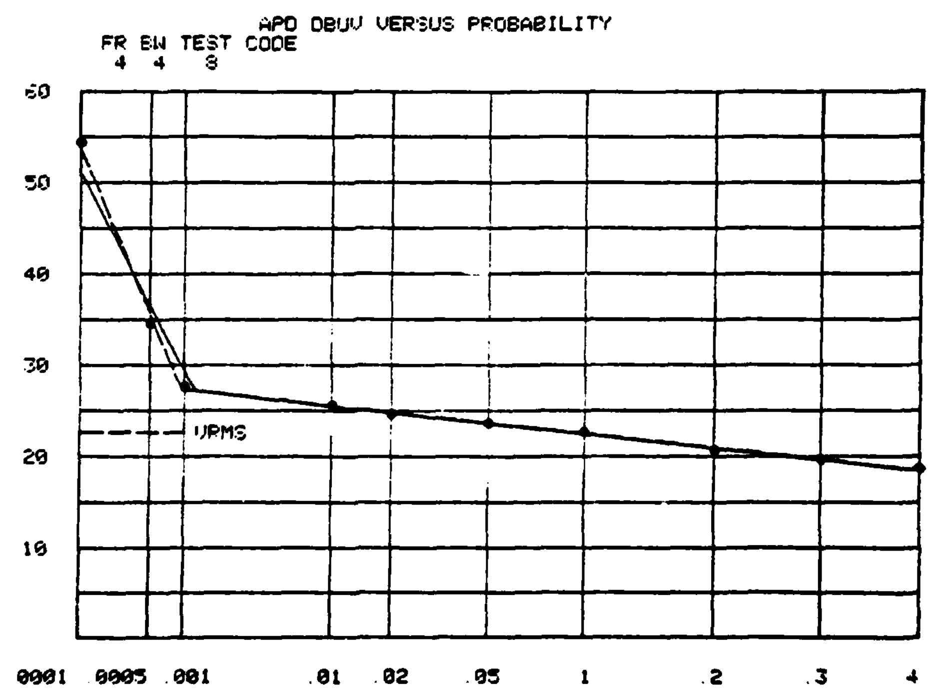


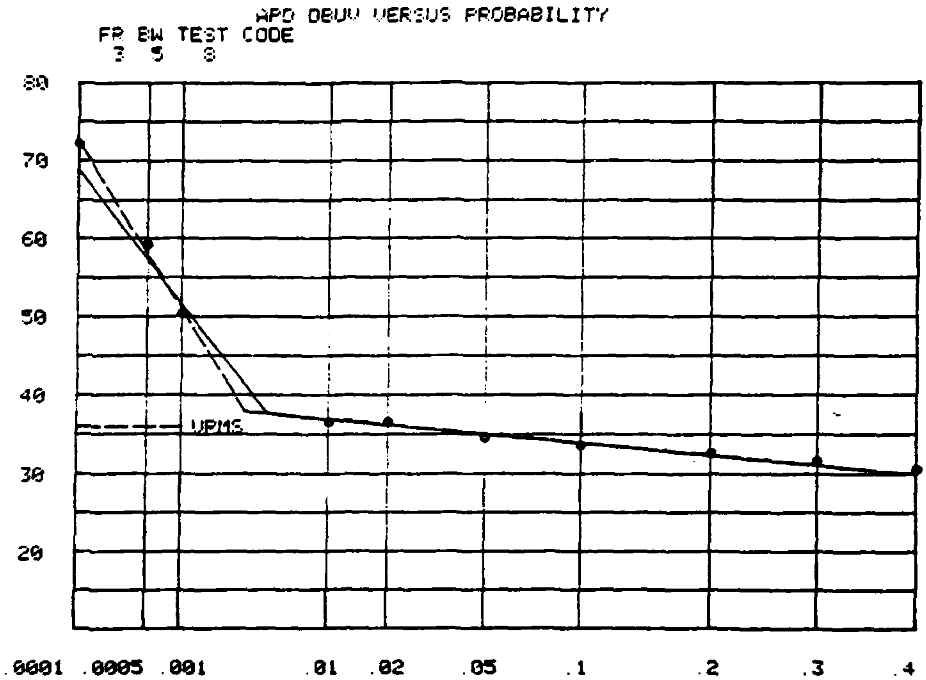
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 9
80
70
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 4 9
80
70
60
50
40
30
20
VPMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

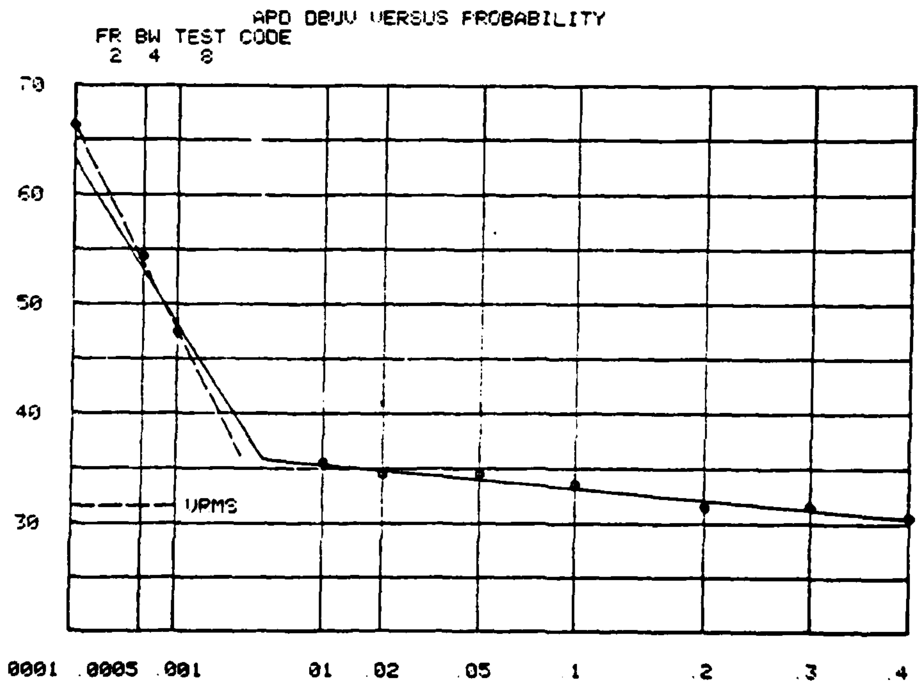

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 5 9
80
70
60
50
40
30
VPMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 8
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

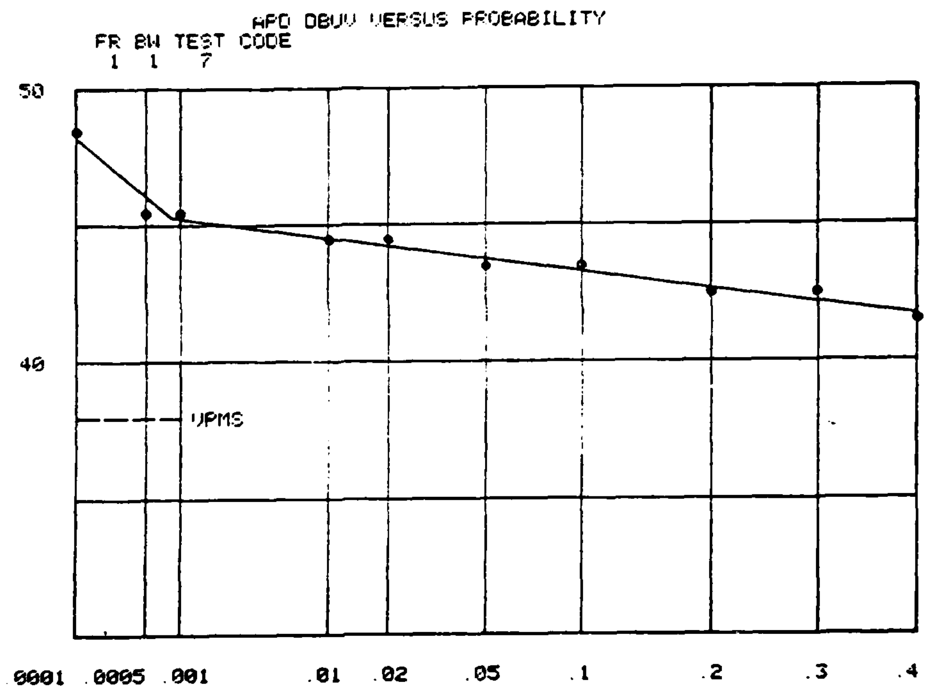

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 4 8
60
50
40
30
20
10
VRMS
0001 0005 .001 .01 .02 .05 1 .2 .3 4

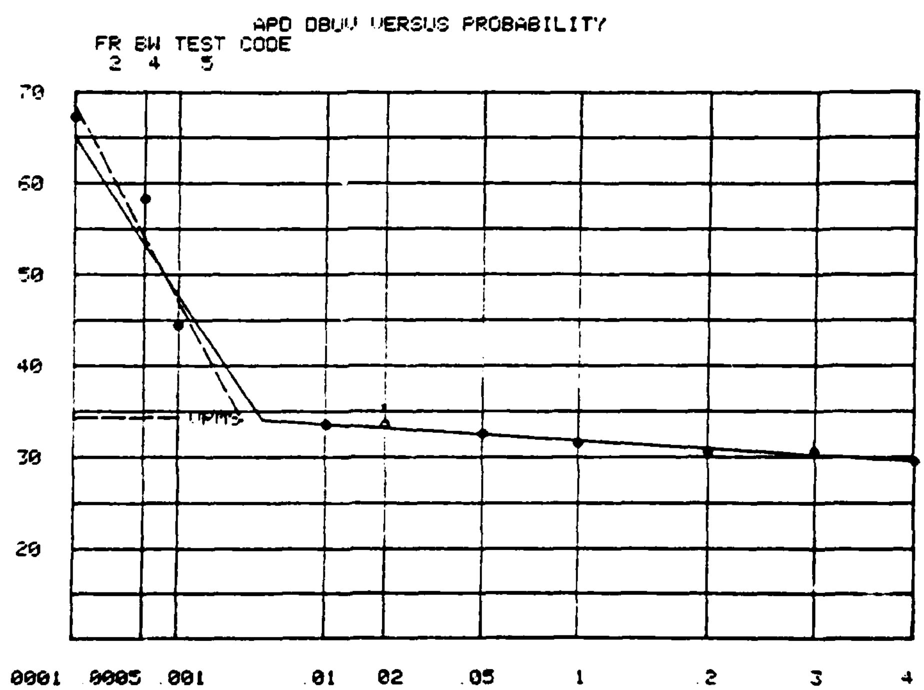


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 8
80
70
60
50
40
30
20
VPMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 4 8
70
60
50
40
30
VPMS
0001 .0005 .001 01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 1 7
50
40
VPMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

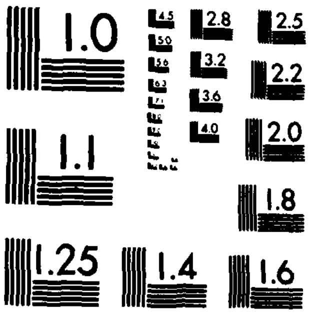

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 4 5
70
60
50
40
VPMS
30
20
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

AD-A121 580 VEHICLE NOISE MEASUREMENTS(U) ARMY ELECTRONIC PROVING GROUND FORT HUACHUCA AZ APR 80 USAEPG-FR-1065-3

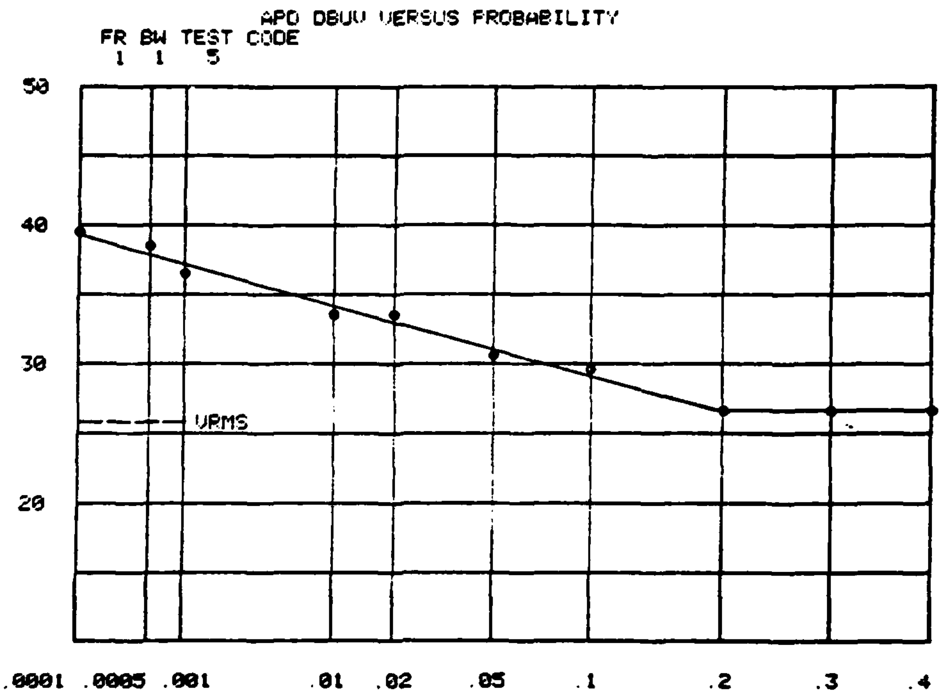
UNCLASSIFIED F/G 20/1 NL

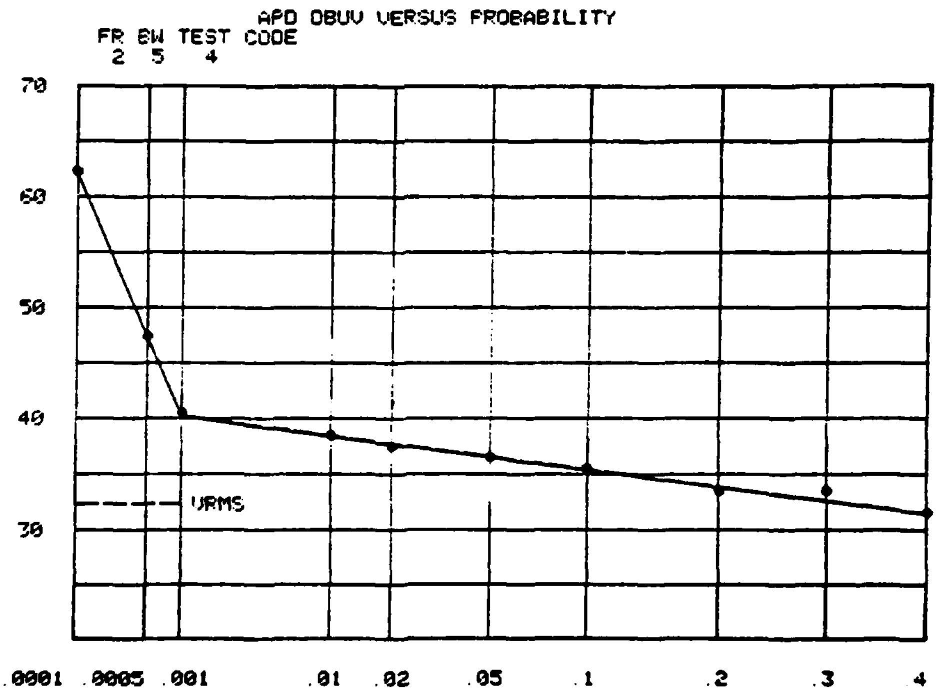
33

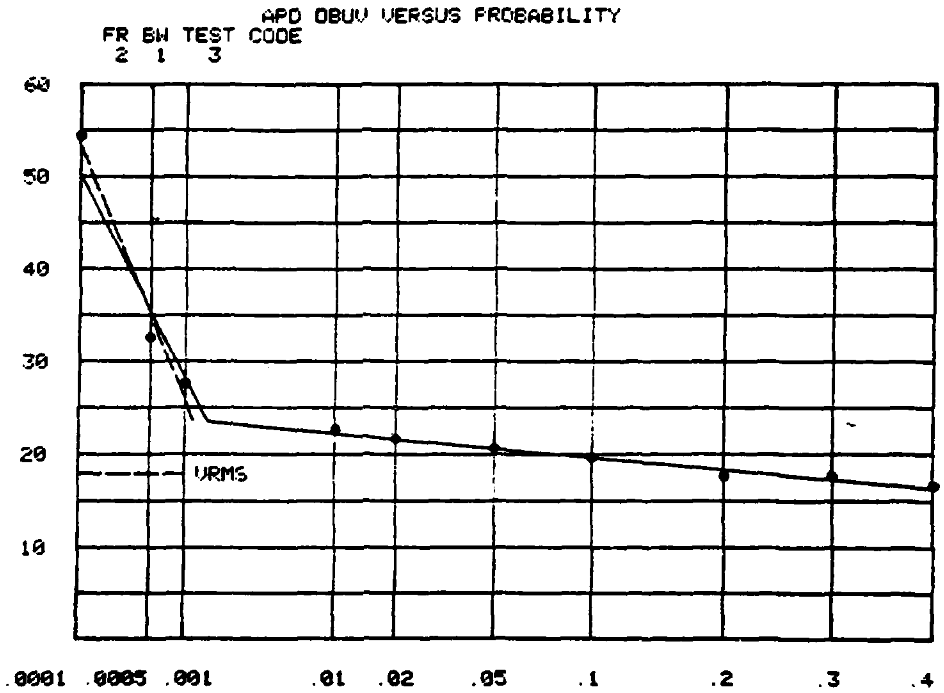
END
DATE
FILMED
DTIC

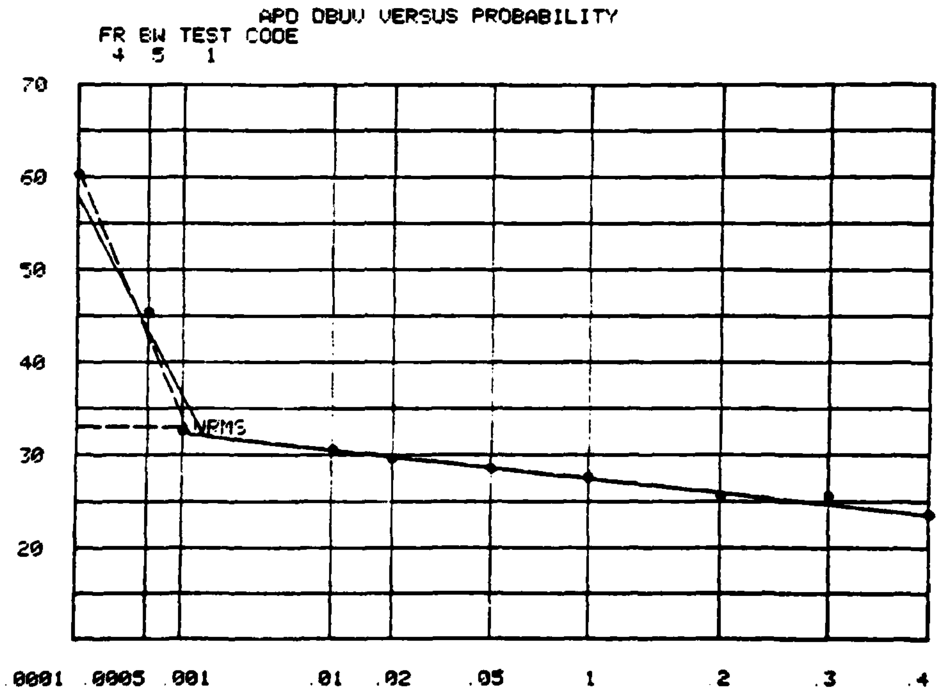


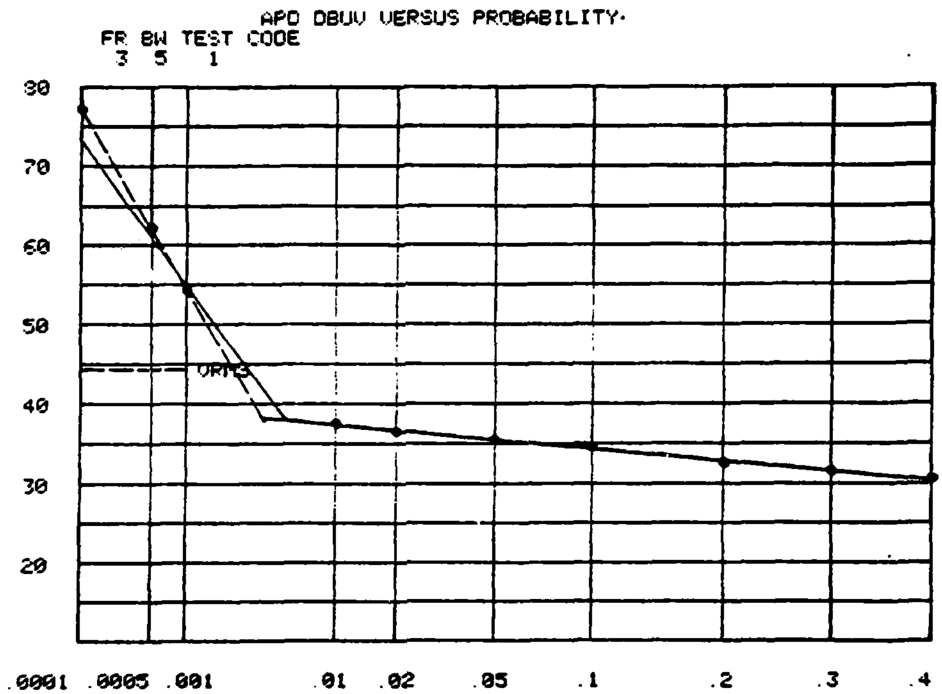
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 1 5
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 5 4
70
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 1 3
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 1
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 1 2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 1
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

3.6 COMPUTER PRINTOUTS OF COMPARISON RESULTS OF MEASURED AND PREDICTED V_v FOR MULTIPLE VEHICLES

This paragraph presents the computer printout results of a comparison analysis between measured and predicted values of V_v for multiple vehicles. Each sheet lists the associated Weibull parameters and intersection points for individual vehicles, the predicted composite, and the measured APD straight-line approximations. These data were compiled for the following tests.

Test Code	Number of Vehicles Tested
16	12
17	6
18	6
19	6
20	3
21	3
22	3
23	2
24	2

The frequency (FREQ) and bandwidth (BW) are shown as part of the top heading for each test entry. Errors in prediction and unexpected measurement results were flagged with the following code:

1. On a "MEASURED" line

   — Measured composite V_v less than for one of the contributing vehicles by more than 10 dB.

- Measured composite V_v less than for one of the contributing vehicles by more than 5 but less than 10 dB.

+ Measured composite V_v greater than largest V_v for a contributing vehicle by more than 5 but less than 10 dB (a possible error condition).

++ Measured composite V_v greater than largest V_v for a contributing vehicle by more than 10 dB (a probable error condition).

2. On a "PREDICTED" line

-- or ++ Predicted V_v less than or greater than measured V_v by more than 10 dB.

- or + Predicted V_v less than or greater than measured V_v by more than 5 but less than 10 dB.

Those entries without a flag on the "PREDICTED" line indicate that the measured V_v was considered to be satisfactorily predicted from the composite.

Plot line descriptions in the table refer to the plots in section 3.7.

MULTIPLE VEHICLE TEST 16 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		29.46	0.6662	-7.219	50.62	32.97	0.0926	SOLID LINE
PREDICTED:	+	34.78	0.7483	-10.742	54.49	30.46	0.3128	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	35.23	0.0109	LONG DASH
	2	NO DATA						
	3	NO DATA						
	4	NO DATA						
	5	NO DATA						
	6	NO DATA						
	7	29.09	0.7851	-9.282	48.21	32.85	0.1004	DASH, 4 DOTS
	8	29.23	0.4913	-3.676	54.22	33.64	0.0564	DASH, 5 DOTS
	9	23.49	0.7218	-6.108	43.64	35.29	0.0100	DASH, 6 DOTS
	10	NO DATA						
	11	29.70	1.4722	-21.256	41.98	31.48	0.2115	DASH, 8 DOTS
	12	NO DATA						

MULTIPLE VEHICLE TEST 16 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		37.77	0.6555	-9.738	59.13	35.39	0.2154	SOLID LINE
PREDICTED:		41.95	0.7616	-13.755	61.44	32.89	0.4706	SQUARES
FROM TEST	1	NO DATA						
	2	32.48	0.5432	-5.625	56.21	37.60	0.0564	SHORT DASH
	3	NO DATA						
	4	NO DATA						
	5	21.93	0.3022	1.781	52.03	40.25	0.0022	DASH, 2 DOTS
	6	NO DATA						
	7	34.20	0.9067	-13.751	51.60	35.95	0.1658	DASH, 4 DOTS
	8	29.28	0.3926	-1.528	56.91	38.82	0.0171	DASH, 5 DOTS
	9	27.16	0.5339	-4.002	51.11	39.09	0.0123	DASH, 6 DOTS
	10	39.35	0.6304	-0.649	61.21	35.01	0.2526	DASH, 7 DOTS
	11	25.30	0.6200	-5.039	47.36	39.79	0.0047	DASH, 8 DOTS
	12	29.51	0.8710	-10.993	47.38	38.59	0.0221	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		43.07	0.7119	-12.923	63.40	35.68	0.3867	SOLID LINE
PREDICTED:		44.49	0.9784	-20.203	61.01	32.12	0.7009	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	39.64	0.0590	LONG DASH
	2	24.20	0.8415	-8.232	42.48	44.70	0.0000	SHORT DASH
	3	NO DATA						
	4	41.04	0.8426	-15.345	59.31	35.57	0.3984	DASH, 1 DOT
	5	NO DATA						
	6	NO DATA						
	7	29.61	0.4334	-2.517	56.12	41.22	0.0125	DASH, 4 DOTS
	8	39.30	0.9827	-17.760	55.77	35.67	0.3877	DASH, 5 DOTS
	9	26.62	0.1931	4.117	57.22	42.75	0.0013	DASH, 6 DOTS
	10	NO DATA						
	11	30.65	0.6369	-7.034	52.37	40.86	0.0191	DASH, 8 DOTS
	12	28.08	0.4355	-2.231	54.53	41.56	0.0082	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	36.95	0.6845	-10.128	57.77	33.42	0.2586	SOLID LINE
PREDICTED:	+	43.95	0.1243	5.615	64.80	45.31	0.0009	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	62.05	0.0000	LONG DASH
	2	NO DATA						
	3	43.21	0.1133	6.260	59.74	46.04	0.0005	DOTTED LINE
	4	24.78	0.9638	-10.346	41.48	71.46	0.0000	DASH, 1 DOT
	5	29.80	0.3738	-1.190	57.96	42.51	0.0088	DASH, 2 DOTS
	6	21.84	0.6199	-3.965	43.90	51.02	0.0000	DASH, 3 DOTS
	7	NO DATA						
	8	27.97	0.5038	-3.619	52.65	43.48	0.0045	DASH, 5 DOTS
	9	29.67	0.4233	-2.304	56.44	42.36	0.0097	DASH, 6 DOTS
	10	23.50	0.7281	-6.209	43.55	53.21	0.0000	DASH, 7 DOTS
	11	26.06	0.3278	0.548	55.49	44.26	0.0024	DASH, 8 DOTS
	12	21.97	0.3653	0.444	50.37	46.00	0.0005	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	42.12	0.4253	-4.998	68.84	35.29	0.1683	SOLID LINE
PREDICTED:		40.28	0.1860	3.078	70.57	42.63	0.0063	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	45.09	0.0008	LONG DASH
	2	NO DATA						
	3	23.77	0.5276	-2.986	47.87	46.07	0.0003	DOTTED LINE
	4	24.15	0.4528	-1.707	50.13	44.94	0.0009	DASH, 1 DOT
	5	35.33	0.2256	2.139	66.53	42.44	0.0072	DASH, 2 DOTS
	6	27.07	0.3891	-1.018	54.80	43.18	0.0042	DASH, 3 DOTS
	7	23.50	0.8415	-7.937	41.78	57.63	0.0000	DASH, 4 DOTS
	8	32.11	0.2664	1.254	62.97	42.41	0.0074	DASH, 5 DOTS
	9	34.17	0.2646	1.035	65.05	41.88	0.0106	DASH, 6 DOTS
	10	24.43	0.4791	-2.269	49.73	45.01	0.0008	DASH, 7 DOTS
	11	29.08	0.2980	0.810	59.27	42.89	0.0052	DASH, 8 DOTS
	12	27.33	0.2648	1.937	58.21	43.74	0.0027	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	46.72	0.3365	-3.129	75.92	35.32	0.1479	SOLID LINE
PREDICTED:		45.91	0.1969	2.096	76.65	39.14	0.0195	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	43.65	0.0001	LONG DASH
	2	26.49	0.6547	-6.024	47.86	40.84	0.0044	SHORT DASH
	3	28.53	0.4484	-2.605	54.63	39.51	0.0147	DOTTED LINE
	4	29.01	0.3104	0.502	58.89	40.09	0.0091	DASH, 1 DOT
	5	39.86	0.2377	1.200	71.05	39.00	0.0217	DASH, 2 DOTS
	6	30.05	0.3361	-0.317	59.26	39.62	0.0135	DASH, 3 DOTS
	7	31.32	0.2090	3.126	62.36	40.91	0.0041	DASH, 4 DOTS
	8	38.24	0.2345	1.500	69.44	39.34	0.0168	DASH, 5 DOTS
	9	37.24	0.2640	0.649	68.14	38.95	0.0225	DASH, 6 DOTS
	10	28.44	0.4414	-2.435	54.73	39.57	0.0141	DASH, 7 DOTS
	11	40.44	0.1683	3.794	69.50	40.69	0.0051	DASH, 8 DOTS
	12	31.54	0.3078	0.179	61.49	39.52	0.0146	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		50.67	0.2836	-1.869	81.19	38.70	0.1002	SOLID LINE
PREDICTED:		50.94	0.1762	2.539	80.64	41.69	0.0153	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	43.19	0.0035	LONG DASH
	2	27.19	0.4062	-1.413	54.44	42.95	0.0046	SHORT DASH
	3	32.52	0.5839	-6.515	55.34	40.72	0.0318	DOTTED LINE
	4	35.24	0.1767	3.903	64.97	43.45	0.0026	DASH, 1 DOT
	5	48.19	0.1459	4.221	74.34	43.01	0.0043	DASH, 2 DOTS
	6	33.88	0.4023	-2.675	61.23	40.94	0.0274	DASH, 3 DOTS
	7	24.51	0.2310	3.208	55.71	44.09	0.0012	DASH, 4 DOTS
	8	43.59	0.1674	3.571	72.56	42.77	0.0056	DASH, 5 DOTS
	9	40.81	0.1913	2.820	71.33	42.46	0.0076	DASH, 6 DOTS
	10	32.50	0.4496	-3.523	58.56	41.12	0.0239	DASH, 7 DOTS
	11	38.67	0.1870	3.189	69.01	42.82	0.0053	DASH, 8 DOTS
	12	36.63	0.1841	3.492	66.81	43.13	0.0038	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	56.64	0.2528	-1.440	87.69	42.66	0.0834	SOLID LINE
PREDICTED:		51.03	0.1767	2.436	81.56	45.03	0.0125	SQUARES
FROM TEST	1	38.05	0.1755	3.701	67.70	46.35	0.0025	LONG DASH
	2	37.64	0.1570	4.502	65.40	46.75	0.0014	SHORT DASH
	3	34.46	0.4908	-4.949	59.46	44.63	0.0186	DOTTED LINE
	4	NO DATA						
	5	43.93	0.1796	3.012	73.85	45.72	0.0058	DASH, 2 DOTS
	6	39.44	0.2973	-0.710	69.65	44.54	0.0203	DASH, 3 DOTS
	7	27.02	0.3184	0.615	56.70	46.62	0.0017	DASH, 4 DOTS
	8	48.54	0.1503	3.976	75.42	46.03	0.0039	DASH, 5 DOTS
	9	NO DATA						
	10	33.74	0.4208	-3.104	60.59	44.97	0.0133	DASH, 7 DOTS
	11	44.50	0.1592	3.862	72.61	46.12	0.0035	DASH, 8 DOTS
	12	34.19	0.1818	3.803	64.25	46.62	0.0017	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		26.85	0.4324	-1.899	53.38	20.43	0.1676	SOLID LINE
PREDICTED:		29.53	0.1945	3.789	60.18	24.90	0.0153	SQUARES
FROM TEST	1	22.08	0.2489	3.025	53.18	24.77	0.0169	LONG DASH
	2	7.89	0.3889	2.717	35.62	27.03	0.0019	SHORT DASH
	3	18.39	0.4722	-0.714	43.86	23.13	0.0506	DOTTED LINE
	4	19.35	0.2617	3.064	50.28	25.06	0.0135	DASH, 1 DOT
	5	14.36	0.3139	2.713	44.16	25.51	0.0091	DASH, 2 DOTS
	6	13.90	0.3319	2.470	43.22	25.49	0.0093	DASH, 3 DOTS
	7	15.91	0.3459	1.887	44.85	24.87	0.0157	DASH, 4 DOTS
	8	22.12	0.2515	2.954	53.19	24.72	0.0176	DASH, 5 DOTS
	9	21.51	0.2400	3.322	52.68	25.04	0.0137	DASH, 6 DOTS
	10	20.71	0.3489	0.997	49.57	23.56	0.0391	DASH, 7 DOTS
	11	11.60	0.3610	2.401	40.12	25.96	0.0060	DASH, 8 DOTS
	12	17.12	0.2734	3.102	47.85	25.32	0.0108	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16   FREQ = 300. MHZ   BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		31.66	0.3617	-1.238	60.16	26.25	0.1061	SOLID LINE
PREDICTED:		33.92	0.1974	3.261	64.67	30.13	0.0150	SQUARES
FROM TEST	1	29.18	0.2071	3.411	60.18	30.63	0.0105	LONG DASH
	2	8.39	0.2805	4.177	38.97	34.00	0.0004	SHORT DASH
	3	22.73	0.2592	2.682	53.70	30.75	0.0096	DOTTED LINE
	4	28.54	0.2048	3.550	59.49	30.80	0.0093	DASH, 1 DOT
	5	16.75	0.3285	2.059	46.17	31.58	0.0050	DASH, 2 DOTS
	6	19.16	0.2951	2.350	49.42	31.15	0.0071	DASH, 3 DOTS
	7	19.13	0.2514	3.333	50.21	31.67	0.0046	DASH, 4 DOTS
	8	NO DATA						
	9	NO DATA						
	10	24.61	0.2969	1.503	54.83	29.67	0.0203	DASH, 7 DOTS
	11	15.61	0.2539	3.722	46.65	32.42	0.0023	DASH, 8 DOTS
	12	23.11	0.2328	3.320	54.31	31.15	0.0071	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16   FREQ = 300. MHZ   BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		36.40	0.2713	0.531	67.17	30.50	0.0534	SOLID LINE
PREDICTED:		38.72	0.2050	2.502	69.67	31.49	0.0237	SQUARES
FROM TEST	1	34.35	0.1841	3.701	64.54	32.43	0.0094	LONG DASH
	2	12.54	0.1852	5.681	42.78	34.57	0.0004	SHORT DASH
	3	29.48	0.2096	3.301	60.53	32.44	0.0093	DOTTED LINE
	4	32.66	0.1992	3.323	63.47	32.28	0.0110	DASH, 1 DOT
	5	19.12	0.2231	4.031	53.31	33.48	0.0025	DASH, 2 DOTS
	6	23.28	0.2884	1.900	53.69	32.30	0.0108	DASH, 3 DOTS
	7	25.36	0.2112	3.683	56.44	32.88	0.0055	DASH, 4 DOTS
	8	NO DATA						
	9	NO DATA						
	10	27.77	0.2533	2.193	58.82	31.99	0.0148	DASH, 7 DOTS
	11	21.35	0.2558	2.946	52.37	32.88	0.0056	DASH, 8 DOTS
	12	28.30	0.1938	3.932	58.93	32.84	0.0058	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16   FREQ = 300. MHZ   BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		39.61	0.2796	-0.173	70.21	34.76	0.0527	SOLID LINE
PREDICTED:	+	46.48	0.1686	3.272	75.57	36.96	0.0129	SQUARES
FROM TEST	1	44.31	0.1376	4.907	68.81	38.27	0.0034	LONG DASH
	2	21.07	0.1534	5.930	48.42	39.92	0.0004	SHORT DASH
	3	32.15	0.1841	3.906	62.33	38.13	0.0040	DOTTED LINE
	4	39.36	0.1756	3.582	69.02	37.52	0.0077	DASH, 1 DOT
	5	26.43	0.3217	0.632	56.03	37.22	0.0101	DASH, 2 DOTS
	6	30.94	0.1989	3.502	61.74	37.97	0.0048	DASH, 3 DOTS
	7	26.71	0.1864	4.328	57.02	38.72	0.0020	DASH, 4 DOTS
	8	NO DATA						
	9	NO DATA						
	10	31.39	0.2767	1.056	62.05	36.67	0.0165	DASH, 7 DOTS
	11	23.66	0.2018	4.141	54.54	38.86	0.0017	DASH, 8 DOTS
	12	35.50	0.1597	4.557	63.67	38.36	0.0031	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 900. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		23.56	0.2192	3.645	54.72	27.70	0.0095	SOLID LINE
PREDICTED:		26.16	0.1776	4.674	55.95	28.31	0.0053	SQUARES
FROM TEST	1	20.97	0.1601	5.706	49.18	29.36	0.0017	LONG DASH
	2	1.46	0.2805	5.149	32.04	31.12	0.0001	SHORT DASH
	3	8.87	0.2060	5.519	39.87	30.05	0.0007	DOTTED LINE
	4	16.41	0.2695	3.280	47.21	28.18	0.0061	DASH, 1 DOT
	5	4.75	0.2677	4.881	35.58	30.45	0.0004	DASH, 2 DOTS
	6	9.46	0.2138	5.307	40.57	29.90	0.0008	DASH, 3 DOTS
	7	16.12	0.4330	0.414	42.63	27.25	0.0139	DASH, 4 DOTS
	8	NO DATA						
	9	NO DATA						
	10	11.79	0.2036	5.294	42.72	29.67	0.0011	DASH, 7 DOTS
	11	21.23	0.1459	6.187	47.38	29.72	0.0011	DASH, 8 DOTS
	12	15.77	0.1796	5.539	45.69	29.52	0.0014	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 16 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	27.34	0.2104	3.499	58.40	32.04	0.0077	SOLID LINE
PREDICTED:	++	48.72	0.1144	5.879	65.78	33.51	0.0024	SQUARES
FROM TEST	1	35.97	0.1160	6.529	53.70	34.32	0.0008	LONG DASH
	2	10.51	0.1692	6.287	39.65	35.16	0.0002	SHORT DASH
	3	NO DATA						
	4	24.71	0.1763	4.845	54.42	33.51	0.0024	DASH, 1 DOT
	5	14.78	0.1553	6.350	42.40	34.94	0.0003	DASH, 2 DOTS
	6	14.19	0.1734	5.855	43.68	34.71	0.0005	DASH, 3 DOTS
	7	10.29	0.3775	2.405	38.34	34.85	0.0004	DASH, 4 DOTS
	8	NO DATA						
	9	NO DATA						
	10	15.46	0.1794	5.573	45.37	34.49	0.0006	DASH, 7 DOTS
	11	48.46	0.0942	7.143	53.05	34.61	0.0005	DASH, 8 DOTS
	12	24.31	0.1351	6.385	48.23	34.55	0.0006	DASH, 9 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		28.97	0.6010	-5.810	51.43	33.83	0.0655	SOLID LINE
PREDICTED:		31.36	0.7543	-9.580	50.97	33.05	0.1433	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	34.96	0.0115	LONG DASH
	2	NO DATA						
	3	NO DATA						
	4	NO DATA						
	9	23.49	0.7218	-6.103	43.64	34.97	0.0113	DASH, 2 DOTS
	11	29.70	1.4722	-21.256	41.98	33.21	0.1242	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		33.23	0.5040	-4.949	57.99	36.29	0.0722	SOLID LINE
PREDICTED:		34.20	0.6197	-7.790	56.26	35.49	0.1234	SQUARES
FROM TEST	1	NO DATA						
	2	32.48	0.5432	-5.625	56.21	36.33	0.0702	SHORT DASH
	3	NO DATA						
	4	NO DATA						
	9	27.16	0.5339	-4.002	51.11	37.83	0.0171	DASH, 2 DOTS
	11	25.30	0.6200	-5.039	47.36	38.47	0.0076	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		37.76	0.4283	-4.147	64.40	35.26	0.1120	SOLID LINE
PREDICTED:		42.53	0.8252	-15.546	61.05	33.15	0.5218	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	35.27	0.1103	LONG DASH
	2	24.20	0.8415	-8.232	42.48	36.80	0.0049	SHORT DASH
	3	NO DATA						
	4	41.04	0.8426	-15.345	59.31	33.38	0.4748	DASH, 1 DOT
	9	26.62	0.1931	4.117	57.22	36.98	0.0028	DASH, 2 DOTS
	11	30.65	0.6369	-7.034	52.37	35.62	0.0674	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	32.39	0.5239	-5.176	56.58	33.00	0.1084	SOLID LINE
PREDICTED:	++	43.58	0.1188	5.930	62.47	34.85	0.0018	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	34.04	0.0182	LONG DASH
	2	NO DATA						
	3	43.21	0.1133	6.260	59.74	34.95	0.0013	DOTTED LINE
	4	24.78	0.9638	-10.346	41.48	34.06	0.0175	DASH, 1 DOT
	9	29.67	0.4233	-2.304	56.44	33.54	0.0490	DASH, 2 DOTS
	11	26.06	0.3278	0.548	55.49	34.09	0.0165	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		37.03	0.5569	-7.189	60.44	34.48	0.1751	SOLID LINE
PREDICTED:		36.18	0.3353	-1.322	65.41	35.52	0.0547	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	36.41	0.0111	LONG DASH
	2	NO DATA						
	3	23.77	0.5276	-2.986	47.87	36.46	0.0100	DOTTED LINE
	4	24.15	0.4528	-1.707	50.13	36.41	0.0110	DASH, 1 DOT
	9	34.17	0.2646	1.035	65.05	36.07	0.0222	DASH, 2 DOTS
	11	29.08	0.2980	0.810	59.27	36.26	0.0153	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		43.91	0.2719	-0.507	74.61	41.57	0.0381	SOLID LINE
PREDICTED:		42.63	0.1770	3.236	72.38	43.01	0.0063	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	45.30	0.0000	LONG DASH
	2	26.49	0.6547	-6.024	47.86	44.03	0.0010	SHORT DASH
	3	28.53	0.4484	-2.605	54.63	43.01	0.0064	DOTTED LINE
	4	29.31	0.3104	0.502	58.89	43.13	0.0053	DASH, 1 DOT
	9	37.24	0.2640	0.649	68.14	42.41	0.0148	DASH, 2 DOTS
	11	40.44	0.1683	3.794	69.50	43.31	0.0039	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	45.83	0.3219	-2.496	75.42	43.56	0.0591	SOLID LINE
PREDICTED:		44.33	0.1958	2.299	75.03	44.37	0.0099	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	44.76	0.0029	LONG DASH
	2	27.19	0.4062	-1.413	51.41	44.76	0.0029	SHORT DASH
	3	32.52	0.5839	-6.515	55.34	44.28	0.0125	DOTTED LINE
	4	35.24	0.1767	3.903	64.97	44.83	0.0022	DASH, 1 DOT
	9	40.81	0.1913	2.820	71.33	44.54	0.0061	DASH, 2 DOTS
	11	38.67	0.1870	3.189	69.01	44.64	0.0043	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	53.96	0.2331	-0.284	85.16	49.89	0.0280	SOLID LINE
PREDICTED:	-	46.33	0.1698	3.232	75.52	50.65	0.0035	SQUARES
FROM TEST	1	38.05	0.1755	3.701	67.70	50.89	0.0014	LONG DASH
	2	37.64	0.1570	4.502	65.43	51.02	0.0008	SHORT DASH
	3	34.46	0.4908	-4.949	59.46	50.63	0.0037	DOTTED LINE
	4	NO DATA						
	9	NO DATA						
	11	44.50	0.1592	3.862	72.61	50.79	0.0021	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		24.57	0.4655	-2.045	50.21	21.99	0.1315	SOLID LINE
PREDICTED:		26.77	0.1949	4.046	57.41	25.33	0.0113	SQUARES
FROM TEST	1	22.00	0.2489	3.025	53.18	24.95	0.0165	LONG DASH
	2	7.89	0.3889	2.717	35.62	26.69	0.0021	SHORT DASH
	3	18.39	0.4722	-0.714	43.86	23.74	0.0458	DOTTED LINE
	4	19.35	0.2617	3.064	50.28	25.17	0.0133	DASH, 1 DOT
	9	21.51	0.2400	3.322	52.68	25.16	0.0135	DASH, 2 DOTS
	11	11.60	0.3610	2.401	40.12	25.87	0.0061	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		29.21	0.2791	1.294	59.82	28.63	0.0340	SOLID LINE
PREDICTED:		32.49	0.2071	3.063	63.49	29.96	0.0159	SQUARES
FROM TEST	1	29.18	0.2071	3.411	60.10	30.40	0.0108	LONG DASH
	2	8.39	0.2805	4.177	38.97	32.92	0.0005	SHORT DASH
	3	22.73	0.2592	2.682	53.70	30.48	0.0100	DOTTED LINE
	4	28.54	0.2048	3.550	59.49	34.53	0.0095	DASH, 1 DOT
	9	NO DATA						
	11	15.61	0.2539	3.722	45.65	31.74	0.0026	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 300. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		33.34	0.2770	0.778	63.99	33.38	0.0311	SOLID LINE
PREDICTED:		37.49	0.2030	2.700	68.39	34.43	0.0156	SQUARES
FROM TEST	1	34.35	0.1841	3.701	64.54	35.23	0.0071	LONG DASH
	2	12.54	0.1852	5.681	42.78	37.63	0.0003	SHORT DASH
	3	29.48	0.2096	3.301	64.53	35.29	0.0067	DOTTED LINE
	4	32.66	0.1992	3.323	63.47	35.10	0.0082	DASH, 1 DOT
	9	NO DATA						
	11	21.35	0.2558	2.946	52.37	35.87	0.0035	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	37.06	0.2526	1.039	68.12	37.92	0.0218	SOLID LINE
PREDICTED:	+	45.73	0.1608	3.692	74.02	38.95	0.0081	SQUARES
FROM TEST	1	44.31	0.1376	4.907	68.81	39.78	0.0030	LONG DASH
	2	21.07	0.1534	5.930	48.42	41.25	0.0003	SHORT DASH
	3	32.15	0.1841	3.906	62.33	39.70	0.0033	DOTTED LINE
	4	39.36	0.1756	3.582	69.02	39.15	0.0065	DASH, 1 DOT
	9	NO DATA						
	11	23.66	0.2018	4.141	54.54	40.36	0.0013	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 900. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		22.23	0.2336	3.400	53.44	27.02	0.0108	SOLID LINE
PREDICTED:		24.90	0.1719	4.979	54.27	28.01	0.0042	SQUARES
FROM TEST	1	20.97	0.1601	5.706	49.18	28.64	0.0018	LONG DASH
	2	1.46	0.2805	5.149	32.01	30.06	0.0002	SHORT DASH
	3	8.87	0.2068	5.519	39.87	29.21	0.0008	DOTTED LINE
	4	16.41	0.2695	3.280	47.21	27.61	0.0067	DASH, 1 DOT
	9	NO DATA						
	11	21.23	0.1459	6.187	47.38	28.96	0.0012	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 17 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	29.73	0.1896	3.936	60.19	31.80	0.0070	SOLID LINE
PREDICTED:	++	48.71	0.1104	6.118	63.86	32.73	0.0020	SQUARES
FROM TEST	1	35.97	0.1160	6.529	53.70	33.26	0.0009	LONG DASH
	2	10.51	0.1692	6.287	39.65	33.95	0.0003	SHORT DASH
	3	NO DATA						
	4	24.71	0.1763	4.845	54.42	32.52	0.0027	DASH, 1 DOT
	9	NO DATA						
	11	48.46	0.0942	7.143	53.05	33.52	0.0006	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	13.26	0.5359	-0.316	37.17	19.99	0.0411	SOLID LINE
PREDICTED:	++	31.06	0.5523	-5.430	54.58	13.27	0.5137	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	18.12	0.1240	LONG DASH
	4	NO DATA						
	8	29.23	0.4913	-3.676	54.22	15.01	0.3670	DOTTED LINE
	9	23.49	0.7218	-6.108	43.64	13.95	0.4580	DASH, 1 DOT
	10	NO DATA						
	12	NO DATA						

MULTIPLE VEHICLE TEST 18 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	17.45	0.6491	-2.993	38.93	20.63	0.0957	SOLID LINE
PREDICTED:	++	40.36	0.6730	-11.016	61.39	9.25	0.8504	SQUARES
FROM TEST	1	NO DATA						
	4	NO DATA						
	8	29.28	0.3926	-1.528	56.91	19.16	0.1878	DOTTED LINE
	9	27.16	0.5339	-4.002	51.11	17.68	0.3074	DASH, 1 DOT
	10	39.35	0.6304	-9.649	61.21	10.90	0.7872	DASH, 2 DOTS
	12	29.51	0.8710	-10.993	47.38	10.85	0.7897	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	23.19	0.3820	-0.119	51.11	28.47	0.0333	SOLID LINE
PREDICTED:	++	44.10	0.9491	-19.291	60.97	1.94	0.9855	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	23.31	0.3290	LONG DASH
	4	41.04	0.8426	-15.345	59.31	10.30	0.9238	SHORT DASH
	8	39.30	0.9827	-17.760	55.77	5.95	0.9677	DOTTED LINE
	9	26.62	0.1931	4.117	57.22	30.83	0.0060	DASH, 1 DOT
	10	NO DATA						
	12	28.08	0.4355	-2.231	54.53	26.90	0.0998	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		29.69	0.7480	-8.832	49.40	18.73	0.5186	SOLID LINE
PREDICTED:		34.01	0.5899	-7.082	56.70	19.56	0.4775	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	24.71	0.2134	LONG DASH
	4	24.78	0.9638	-10.346	41.48	22.38	0.3308	SHORT DASH
	8	27.97	0.5038	-3.619	52.65	26.66	0.1301	DOTTED LINE
	9	29.67	0.4233	-2.304	56.44	27.25	0.1086	DASH, 1 DOT
	10	23.50	0.7281	-6.209	43.55	28.21	0.0784	DASH, 2 DOTS
	12	21.97	0.3653	0.444	50.37	31.71	0.0150	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		34.72	0.3463	-1.380	63.65	27.00	0.1181	SOLID LINE
PREDICTED:		37.45	0.3420	-1.729	66.49	26.38	0.1500	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	28.77	0.0505	LONG DASH
	4	24.15	0.4528	-1.707	50.13	28.87	0.0478	SHORT DASH
	8	32.11	0.2664	1.254	62.97	29.26	0.0378	DOTTED LINE
	9	34.17	0.2646	1.035	65.05	28.91	0.0468	DASH, 1 DOT
	10	24.43	0.4791	-2.269	49.73	28.55	0.0570	DASH, 2 DOTS
	12	27.33	0.2648	1.937	58.21	30.22	0.0198	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		39.80	0.2850	-0.374	70.30	30.61	0.0817	SOLID LINE
PREDICTED:		41.73	0.1919	2.706	72.20	32.88	0.0211	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	34.86	0.0036	LONG DASH
	4	29.01	0.3104	0.502	58.89	32.50	0.0277	SHORT DASH
	8	38.24	0.2345	1.500	69.44	32.17	0.0345	DOTTED LINE
	9	37.24	0.2640	0.649	68.14	31.62	0.0480	DASH, 1 DOT
	10	28.44	0.4414	-2.435	54.73	31.16	0.0620	DASH, 2 DOTS
	12	31.54	0.3078	0.179	61.49	31.96	0.0394	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		42.90	0.2526	0.300	73.96	34.11	0.0556	SOLID LINE
PREDICTED:		46.65	0.1911	2.269	77.17	35.46	0.0253	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	37.04	0.0075	LONG DASH
	4	35.24	0.1767	3.903	61.97	37.45	0.0052	SHORT DASH
	8	43.59	0.1674	3.571	72.56	36.72	0.0099	DOTTED LINE
	9	40.81	0.1913	2.820	71.33	36.27	0.0142	DASH, 1 DOT
	10	32.50	0.4496	-3.523	58.56	33.28	0.0831	DASH, 2 DOTS
	12	36.63	0.1841	3.492	65.81	37.05	0.0074	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		45.30	0.2375	0.558	76.49	38.66	0.0379	SOLID LINE
PREDICTED:		49.17	0.1571	3.592	77.02	39.05	0.0091	SQUARES
FROM TEST	1	38.05	0.1755	3.701	67.70	40.32	0.0050	LONG DASH
	4	NO DATA						
	8	48.54	0.1503	3.976	75.42	40.09	0.0068	DOTTED LINE
	9	NO DATA						
	10	33.74	0.4208	-3.104	60.59	38.24	0.0442	DASH, 2 DOTS
	12	34.19	0.1818	3.803	64.25	40.54	0.0037	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	27.50	0.3892	-1.105	55.23	20.99	0.1373	SOLID LINE
PREDICTED:		28.57	0.2088	3.420	59.60	24.63	0.0188	SQUARES
FROM TEST	1	22.09	0.2489	3.025	53.18	24.77	0.0169	LONG DASH
	4	19.35	0.2617	3.064	54.28	25.06	0.0135	SHORT DASH
	8	22.12	0.2515	2.954	53.19	24.72	0.0176	DOTTED LINE
	9	21.51	0.2400	3.322	52.68	25.04	0.0137	DASH, 1 DOT
	10	20.71	0.3489	0.997	49.57	23.56	0.0391	DASH, 2 DOTS
	12	17.12	0.2734	3.102	47.85	25.32	0.0108	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		32.53	0.2868	0.611	62.98	26.25	0.0646	SOLID LINE
PREDICTED:		33.06	0.2054	3.068	64.02	27.71	0.0202	SQUARES
FROM TEST	1	29.18	0.2071	3.411	60.18	28.11	0.0137	LONG DASH
	4	28.51	0.2048	3.550	59.49	28.22	0.0122	SHORT DASH
	8	NO DATA						
	9	NO DATA						
	10	24.61	0.2969	1.503	54.83	27.37	0.0273	DASH, 2 DOTS
	12	23.11	0.2328	3.320	54.31	28.41	0.0101	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 300. MHZ BW = 100. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	35.59	0.2599	0.994	66.54	31.98	0.0379	SOLID LINE
PREDICTED:	37.62	0.2033	2.677	68.53	32.80	0.0185	SQUARES
FROM TEST 1	34.35	0.1841	3.701	64.54	33.57	0.0084	LONG DASH
4	32.66	0.1992	3.323	63.47	33.43	0.0098	SHORT DASH
8	NO DATA						
9	NO DATA						
10	27.77	0.2533	2.193	58.82	33.17	0.0128	DASH, 2 DOTS
12	28.30	0.1938	3.932	58.93	33.99	0.0051	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 300. MHZ BW = 300. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	46.83	0.1845	2.538	77.03	39.09	0.0163	SOLID LINE
PREDICTED:	46.06	0.1623	3.596	74.52	40.08	0.0079	SQUARES
FROM TEST 1	44.31	0.1376	4.907	68.81	41.03	0.0027	LONG DASH
4	39.36	0.1756	3.582	69.02	40.38	0.0057	SHORT DASH
8	NO DATA						
9	NO DATA						
10	31.39	0.2767	1.056	62.05	39.77	0.0108	DASH, 2 DOTS
12	35.50	0.1597	4.557	63.67	41.15	0.0023	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 900. MHZ BW = 100. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	22.22	0.2548	2.858	53.25	25.84	0.0162	SOLID LINE
PREDICTED:	23.41	0.1843	4.703	53.61	26.62	0.0055	SQUARES
FROM TEST 1	20.97	0.1601	5.706	49.18	27.32	0.0021	LONG DASH
4	16.41	0.2695	3.280	47.21	26.31	0.0081	SHORT DASH
8	NO DATA						
9	NO DATA						
10	11.79	0.2036	5.294	42.72	27.51	0.0016	DASH, 2 DOTS
12	15.77	0.1796	5.539	45.69	27.42	0.0018	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 18 FREQ = 900. MHZ BW = 300. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED: -	27.38	0.2134	3.401	58.49	30.98	0.0092	SOLID LINE
PREDICTED: +	36.57	0.1370	5.468	60.94	31.76	0.0030	SQUARES
FROM TEST 1	35.97	0.1160	6.529	53.70	32.50	0.0010	LONG DASH
4	24.71	0.1763	4.845	54.42	31.76	0.0030	SHORT DASH
8	NO DATA						
9	NO DATA						
10	15.46	0.1794	5.573	45.37	32.57	0.0008	DASH, 2 DOTS
12	24.31	0.1351	6.385	48.23	32.67	0.0007	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	8.69	1.1874	-4.067	23.09	17.37	0.0148	SOLID LINE
PREDICTED:	++	34.45	0.7447	-10.545	54.22	2.83	0.8937	SQUARES
FROM TEST	2	NO DATA						
	7	29.09	0.7851	-9.282	48.21	4.68	0.8352	SHORT DASH
	8	29.23	0.4913	-3.676	54.22	10.39	0.4621	DOTTED LINE
	9	23.49	0.7218	-6.108	43.64	8.73	0.6027	DASH, 1 DOT
	11	29.70	1.4722	-21.256	41.98	-23.27	0.9999	DASH, 2 DOTS
	12	NO DATA						

MULTIPLE VEHICLE TEST 19 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	8.38	0.6546	-0.095	29.75	22.28	0.0053	SOLID LINE
PREDICTED:	++	38.43	0.7850	-12.946	57.55	4.49	0.9267	SQUARES
FROM TEST	2	32.48	0.5432	-5.625	56.21	13.29	0.5333	LONG DASH
	7	34.20	0.9067	-13.751	51.60	3.58	0.9406	SHORT DASH
	8	29.28	0.3926	-1.528	56.91	16.95	0.2201	DOTTED LINE
	9	27.16	0.5339	-4.002	51.11	15.30	0.3608	DASH, 1 DOT
	11	25.30	0.6200	-5.039	47.36	14.79	0.4064	DASH, 2 DOTS
	12	29.51	0.3710	-10.993	47.38	8.03	0.8370	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	15.88	0.8691	-5.036	33.78	26.23	0.0132	SOLID LINE
PREDICTED:	++	40.76	0.1281	5.619	62.80	27.11	0.0043	SQUARES
FROM TEST	2	24.20	0.8415	-8.232	42.48	20.23	0.3441	LONG DASH
	7	29.61	0.4334	-2.517	56.12	22.18	0.1837	SHORT DASH
	8	39.30	0.9827	-17.760	55.77	5.17	0.9704	DOTTED LINE
	9	26.62	0.1931	4.117	57.22	26.44	0.0096	DASH, 1 DOT
	11	30.65	0.6369	-7.034	52.37	19.00	0.4504	DASH, 2 DOTS
	12	28.08	0.4355	-2.231	54.53	22.57	0.1565	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	8.92	0.5056	1.161	33.55	17.59	0.0263	SOLID LINE
PREDICTED:	++	33.21	0.5132	-5.150	57.65	9.30	0.5891	SQUARES
FROM TEST	2	NO DATA						
	7	NO DATA						
	8	27.97	0.5038	-3.619	52.65	11.25	0.4341	DOTTED LINE
	9	29.67	0.4233	-2.304	56.44	12.32	0.3422	DASH, 1 DOT
	11	26.06	0.3278	0.548	55.49	14.98	0.1358	DASH, 2 DOTS
	12	21.97	0.3653	0.444	50.37	15.19	0.1226	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	12.49	0.4321	1.212	39.02	22.10	0.0189	SOLID LINE
PREDICTED:	++	37.63	0.3402	-1.707	66.73	17.17	0.2665	SQUARES
FROM TEST	2	NO DATA						
	7	23.50	0.8415	-7.937	41.78	13.37	0.5557	SHORT DASH
	8	32.11	0.2664	1.254	62.97	20.11	0.0843	DOTTED LINE
	9	34.17	0.2646	1.035	65.05	19.81	0.0982	DASH, 1 DOT
	11	29.08	0.2980	0.810	59.27	19.94	0.0917	DASH, 2 DOTS
	12	27.33	0.2648	1.937	58.21	20.94	0.0519	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	--	18.78	0.3529	1.256	47.52	26.85	0.0188	SOLID LINE
PREDICTED:	++	44.15	0.1971	2.262	74.89	25.60	0.0493	SQUARES
FROM TEST	2	26.49	0.6547	-6.024	47.86	22.14	0.2658	LONG DASH
	7	31.32	0.2090	3.126	62.36	26.70	0.0202	SHORT DASH
	8	38.24	0.2345	1.500	69.44	25.29	0.0611	DOTTED LINE
	9	37.24	0.2640	0.649	68.14	24.75	0.0851	DASH, 1 DOT
	11	40.44	0.1683	3.794	69.50	26.83	0.0178	DASH, 2 DOTS
	12	31.54	0.3078	0.179	61.49	24.84	0.0811	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	--	22.47	0.2142	3.903	53.58	32.83	0.0040	SOLID LINE
PREDICTED:	++	46.73	0.1944	2.120	77.33	30.46	0.0399	SQUARES
FROM TEST	2	27.19	0.4062	-1.413	54.44	30.08	0.0524	LONG DASH
	7	24.51	0.2310	3.208	55.71	32.28	0.0072	SHORT DASH
	8	43.59	0.1674	3.571	72.56	31.57	0.0153	DOTTED LINE
	9	40.81	0.1913	2.820	71.33	31.17	0.0223	DASH, 1 DOT
	11	38.67	0.1870	3.189	69.01	31.49	0.0165	DASH, 2 DOTS
	12	36.63	0.1841	3.492	66.81	31.77	0.0125	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	--	27.54	0.1753	4.631	57.18	37.73	0.0020	SOLID LINE
PREDICTED:	++	50.32	0.1654	3.102	79.11	35.84	0.0176	SQUARES
FROM TEST	2	37.64	0.1570	4.502	65.48	37.18	0.0040	LONG DASH
	7	27.02	0.3184	0.615	56.70	36.14	0.0131	SHORT DASH
	8	48.54	0.1503	3.976	75.42	36.48	0.0091	DOTTED LINE
	9	NO DATA						
	11	44.50	0.1592	3.862	72.61	36.54	0.0086	DASH, 2 DOTS
	12	34.19	0.1818	3.803	64.25	36.92	0.0055	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:		26.98	0.2748	1.716	57.68	26.58	0.0320	SOLID LINE
PREDICTED:		26.16	0.1965	4.054	56.88	28.48	0.0079	SQUARES
FROM TEST	2	7.89	0.3989	2.717	35.62	30.88	0.0006	LONG DASH
	7	15.91	0.3459	1.887	44.85	28.42	0.0083	SHORT DASH
	8	22.12	0.2515	2.954	53.19	28.00	0.0118	DOTTED LINE
	9	21.51	0.2400	3.322	52.68	28.31	0.0091	DASH, 1 DOT
	11	11.60	0.3610	2.401	44.12	29.64	0.0026	DASH, 2 DOTS
	12	17.12	0.2734	3.102	47.85	28.71	0.0065	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	+	29.77	0.2970	0.735	59.99	30.05	0.0366	SOLID LINE
PREDICTED:		25.17	0.1994	4.063	55.93	32.04	0.0049	SQUARES
FROM TEST	2	8.39	0.2805	4.177	38.97	33.66	0.0004	LONG DASH
	7	19.13	0.2514	3.333	54.21	32.16	0.0042	SHORT DASH
	8	NO DATA						
	9	NO DATA						
	11	15.61	0.2539	3.722	46.65	32.64	0.0022	DASH, 2 DOTS
	12	23.11	0.2328	3.320	54.31	31.81	0.0065	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 300. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	37.24	0.2016	2.776	68.11	35.32	0.0135	SOLID LINE
PREDICTED:	-	30.63	0.2018	3.432	61.56	36.40	0.0059	SQUARES
FROM TEST	2	12.54	0.1852	5.681	42.78	38.73	0.0002	LONG DASH
	7	25.36	0.2112	3.683	56.44	36.91	0.0033	SHORT DASH
	8	NO DATA						
	9	NO DATA						
	11	21.35	0.2558	2.946	52.37	37.02	0.0028	DASH, 2 DOTS
	12	28.30	0.1938	3.932	58.93	36.82	0.0036	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001	INTERSECT.	AT P	PLOT LINE
MEASURED:		37.29	0.1938	3.064	67.91	40.61	0.0067	SOLID LINE
PREDICTED:		36.39	0.1703	4.053	65.63	41.10	0.0034	SQUARES
FROM TEST	2	21.07	0.1534	5.930	48.42	42.73	0.0002	LONG DASH
	7	26.71	0.1864	4.328	57.02	41.76	0.0013	SHORT DASH
	8	NO DATA						
	9	NO DATA						
	11	23.66	0.2018	4.141	54.54	41.90	0.0010	DASH, 2 DOTS
	12	35.50	0.1597	4.557	63.67	41.41	0.0022	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 900. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001	INTERSECT.	AT P	PLOT LINE
MEASURED:		19.28	0.2535	3.263	50.33	26.19	0.0105	SOLID LINE
PREDICTED:		23.26	0.1568	5.639	51.07	27.16	0.0025	SQUARES
FROM TEST	2	1.46	0.2805	5.149	32.04	28.47	0.0003	LONG DASH
	7	16.12	0.4330	0.414	42.63	25.40	0.0202	SHORT DASH
	8	NO DATA						
	9	NO DATA						
	11	21.23	0.1459	6.187	47.38	27.57	0.0014	DASH, 2 DOTS
	12	15.77	0.1796	5.539	45.69	27.38	0.0018	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 19 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	22.81	0.2104	3.976	53.87	31.30	0.0048	SOLID LINE
PREDICTED:	++	48.47	0.0998	6.784	57.31	32.77	0.0010	SQUARES
FROM TEST	2	10.51	0.1692	6.287	39.65	33.52	0.0003	LONG DASH
	7	10.29	0.3775	2.405	38.34	33.00	0.0007	SHORT DASH
	8	NO DATA						
	9	NO DATA						
	11	48.46	0.0942	7.143	53.05	33.07	0.0006	DASH, 2 DOTS
	12	24.31	0.1351	6.385	48.23	32.97	0.0007	DASH, 3 DOTS

MULTIPLE VEHICLE TEST 20 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	18.01	0.4008	0.543	45.41	18.50	0.0699	SOLID LINE
PREDICTED:	++	33.00	0.6627	-8.323	54.22	5.81	0.7951	SQUARES
FROM TEST	8	29.23	0.4913	-3.676	54.22	12.80	0.4128	LONG DASH
	9	23.49	0.7218	-6.108	43.64	10.80	0.5482	SHORT DASH
	11	29.70	1.4722	-21.256	41.98	-96.79	1.0000	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		26.47	0.2855	1.513	56.95	22.67	0.0505	SOLID LINE
PREDICTED:	+	32.28	0.5043	-4.714	56.94	17.72	0.3888	SQUARES
FROM TEST	8	29.28	0.3926	-1.528	56.91	20.40	0.1705	LONG DASH
	9	27.16	0.5339	-4.002	51.11	19.02	0.2777	SHORT DASH
	11	25.30	0.6200	-5.039	47.36	18.71	0.3037	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	30.16	0.2715	1.373	60.92	29.35	0.0323	SOLID LINE
PREDICTED:	+	40.05	0.1184	6.162	58.78	32.79	0.0016	SQUARES
FROM TEST	8	39.30	0.9827	-17.760	55.77	1.01	0.9814	LONG DASH
	9	26.62	0.1931	4.117	57.22	31.62	0.0054	SHORT DASH
	11	30.65	0.6369	-7.034	52.37	23.00	0.3433	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	8.70	0.5826	0.451	31.55	16.16	0.0377	SOLID LINE
PREDICTED:	++	32.91	0.5033	-4.852	57.60	8.31	0.5889	SQUARES
FROM TEST	8	27.97	0.5038	-3.619	52.65	9.93	0.4616	LONG DASH
	9	29.67	0.4233	-2.304	56.44	11.07	0.3646	SHORT DASH
	11	26.06	0.3278	0.548	55.49	13.80	0.1481	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	12.72	0.3349	2.617	41.96	22.49	0.0129	SOLID LINE
PREDICTED:	++	37.03	0.3222	-1.087	66.61	17.78	0.2219	SQUARES
FROM TEST	8	32.11	0.2664	1.254	62.97	20.11	0.0843	LONG DASH
	9	34.17	0.2646	1.035	65.05	19.81	0.0982	SHORT DASH
	11	29.08	0.2980	0.810	59.27	19.94	0.0917	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	20.01	0.3647	0.812	48.43	26.54	0.0254	SOLID LINE
PREDICTED:	++	43.58	0.1994	2.225	74.39	25.65	0.0494	SQUARES
FROM TEST	8	38.24	0.2345	1.500	69.44	25.34	0.0600	LONG DASH
	9	37.24	0.2640	0.649	68.11	24.80	0.0848	SHORT DASH
	11	40.44	0.1683	3.794	69.50	26.90	0.0177	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	22.90	0.2104	3.967	53.96	32.20	0.0044	SOLID LINE
PREDICTED:	++	46.21	0.1917	2.285	76.75	29.99	0.0376	SQUARES
FROM TEST	8	43.59	0.1674	3.571	72.56	30.98	0.0160	LONG DASH
	9	40.81	0.1913	2.820	71.33	30.57	0.0234	SHORT DASH
	11	38.67	0.1870	3.189	69.01	30.90	0.0173	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	28.38	0.1732	4.631	57.86	37.53	0.0022	SOLID LINE
PREDICTED:	++	49.96	0.1612	3.332	78.30	35.83	0.0152	SQUARES
FROM TEST	8	48.54	0.1503	3.976	75.42	36.31	0.0093	LONG DASH
	9	NO DATA						
	11	44.50	0.1592	3.862	72.61	36.36	0.0088	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		18.28	0.3619	1.178	46.77	23.51	0.0304	SOLID LINE
PREDICTED:	+	25.01	0.2946	1.501	55.28	23.14	0.0452	SQUARES
FROM TEST	8	22.12	0.2515	2.954	53.19	24.33	0.0184	LONG DASH
	9	21.51	0.2400	3.322	52.68	24.61	0.0144	SHORT DASH
	11	11.60	0.3610	2.401	40.12	25.37	0.0068	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	24.50	0.2500	2.693	55.59	29.18	0.0135	SOLID LINE
PREDICTED:	-	15.61	0.2539	3.722	46.65	30.28	0.0033	SQUARES
FROM TEST	8	NO DATA						
	9	NO DATA						
	11	15.61	0.2539	3.722	46.65	30.28	0.0033	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 300. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	+	27.66	0.1972	3.885	58.41	34.20	0.0049	SOLID LINE
PREDICTED:	-	21.35	0.2558	2.946	52.37	33.98	0.0047	SQUARES
FROM TEST	8	NO DATA						
	9	NO DATA						
	11	21.35	0.2558	2.946	52.37	33.98	0.0047	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	++	40.63	0.1354	5.268	64.62	39.73	0.0019	SOLID LINE
PREDICTED:	--	23.66	0.2018	4.141	54.54	39.90	0.0014	SQUARES
FROM TEST	8	NO DATA						
	9	NO DATA						
	11	23.66	0.2018	4.141	54.54	39.90	0.0014	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 900. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		20.21	0.1902	4.820	50.70	27.15	0.0041	SOLID LINE
PREDICTED:		21.23	0.1459	6.187	47.38	27.90	0.0013	SQUARES
FROM TEST	8	NO DATA						
	9	NO DATA						
	11	21.23	0.1459	6.187	47.38	27.90	0.0013	DOTTED LINE

MULTIPLE VEHICLE TEST 20 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	33.80	0.1292	6.015	56.16	31.44	0.0017	SOLID LINE
PREDICTED:	++	48.46	0.0942	7.143	53.05	31.92	0.0007	SQUARES
FROM TEST	8	NO DATA						
	9	NO DATA						
	11	48.46	0.0942	7.143	53.05	31.92	0.0007	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT	P	PLOT LINE
MEASURED:		26.76	0.6850	-6.648	47.56	32.99	0.0540	SOLID LINE
PREDICTED:		30.22	0.5157	-4.438	54.60	32.69	0.0814	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	33.71	0.0147	LONG DASH
	8	29.23	0.4913	-3.676	54.22	32.88	0.0636	SHORT DASH
	12	NO DATA						

MULTIPLE VEHICLE TEST 21 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT	P	PLOT LINE
MEASURED:		28.61	0.3975	-1.507	56.10	36.22	0.0245	SOLID LINE
PREDICTED:		32.36	0.5089	-4.837	56.91	35.00	0.0780	SQUARES
FROM TEST	1	NO DATA						
	8	29.28	0.3926	-1.528	56.91	36.12	0.0273	SHORT DASH
	12	29.51	0.8710	-10.993	47.38	35.20	0.0663	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT	P	PLOT LINE
MEASURED:	-	31.46	0.3437	-0.748	60.46	38.29	0.0217	SOLID LINE
PREDICTED:	+	41.01	0.7729	-13.668	60.32	32.89	0.4483	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	36.66	0.0920	LONG DASH
	8	39.30	0.9827	-17.760	55.77	32.06	0.5328	SHORT DASH
	12	28.08	0.4355	-2.231	54.53	38.55	0.0160	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT	P	PLOT LINE
MEASURED:		32.90	0.4826	-4.378	58.11	27.87	0.1797	SOLID LINE
PREDICTED:		30.28	0.5795	-5.773	53.20	27.82	0.1839	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	29.05	0.0901	LONG DASH
	8	27.97	0.5038	-3.619	52.65	28.94	0.0975	SHORT DASH
	12	21.97	0.3653	0.444	50.37	30.89	0.0172	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT	P	PLOT LINE
MEASURED:	+	39.72	0.2888	-0.484	70.12	31.65	0.0771	SOLID LINE
PREDICTED:	-	33.83	0.3147	-0.367	63.61	31.99	0.0534	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	32.97	0.0237	LONG DASH
	8	32.11	0.2664	1.254	62.97	32.88	0.0257	SHORT DASH
	12	27.33	0.2648	1.937	58.21	33.57	0.0130	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT	P	PLOT LINE
MEASURED:	+	44.29	0.2461	0.361	75.42	35.11	0.0529	SOLID LINE
PREDICTED:	-	39.11	0.2851	-0.277	69.60	35.14	0.0512	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	37.18	0.0017	LONG DASH
	8	38.24	0.2345	1.500	69.44	35.72	0.0246	SHORT DASH
	12	31.54	0.3078	0.179	61.49	35.72	0.0249	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		48.16	0.2189	0.961	79.32	38.88	0.0360	SOLID LINE
PREDICTED:		44.68	0.1783	2.998	74.52	39.37	0.0114	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	39.61	0.0056	LONG DASH
	8	43.59	0.1674	3.571	72.56	39.51	0.0077	SHORT DASH
	12	36.63	0.1841	3.492	66.81	39.61	0.0057	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		52.92	0.1849	1.958	83.15	43.74	0.0187	SOLID LINE
PREDICTED:		49.04	0.1581	3.557	77.01	44.17	0.0063	SQUARES
FROM TEST	1	38.05	0.1755	3.701	67.70	44.39	0.0032	LONG DASH
	8	48.54	0.1503	3.976	75.42	44.27	0.0046	SHORT DASH
	12	34.19	0.1818	3.803	64.25	44.49	0.0023	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		20.97	0.2496	3.144	52.06	20.68	0.0238	SOLID LINE
PREDICTED:		25.75	0.2115	3.634	56.83	20.73	0.0218	SQUARES
FROM TEST	1	22.08	0.2489	3.025	53.18	20.49	0.0271	LONG DASH
	8	22.12	0.2515	2.954	53.19	20.44	0.0282	SHORT DASH
	12	17.12	0.2734	3.102	47.85	20.86	0.0195	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		25.56	0.2532	2.475	56.61	25.39	0.0245	SOLID LINE
PREDICTED:		30.10	0.2050	3.383	61.06	25.53	0.0186	SQUARES
FROM TEST	1	29.18	0.2071	3.411	60.18	25.59	0.0176	LONG DASH
	8	NO DATA						
	12	23.11	0.2328	3.320	54.31	25.84	0.0136	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 300. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		30.15	0.2335	2.481	61.35	30.02	0.0189	SOLID LINE
PREDICTED:	+	35.30	0.1913	3.348	65.82	30.55	0.0145	SQUARES
FROM TEST	1	34.35	0.1841	3.701	64.54	30.84	0.0110	LONG DASH
	8	NO DATA						
	12	28.33	0.1938	3.932	58.93	31.30	0.0069	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	34.70	0.1841	3.671	64.88	35.77	0.0069	SOLID LINE
PREDICTED:	++	44.83	0.1462	4.452	71.03	35.84	0.0061	SQUARES
FROM TEST	1	44.31	0.1376	4.907	68.81	36.16	0.0041	LONG DASH
	8	NO DATA						
	12	35.50	0.1597	4.557	63.67	36.22	0.0039	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 900. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		17.09	0.1770	5.496	46.85	27.21	0.0021	SOLID LINE
PREDICTED:		22.08	0.1720	5.218	51.46	26.68	0.0036	SQUARES
FROM TEST	1	20.97	0.1601	5.706	49.18	27.02	0.0022	LONG DASH
	8	NO DATA						
	12	15.77	0.1796	5.539	45.69	27.13	0.0019	DOTTED LINE

MULTIPLE VEHICLE TEST 21 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	--	18.47	0.1849	5.140	48.70	31.94	0.0016	SOLID LINE
PREDICTED:	++	36.24	0.1227	6.172	56.56	31.94	0.0015	SQUARES
FROM TEST	1	35.97	0.1160	6.529	53.70	32.21	0.0010	LONG DASH
	8	NO DATA						
	12	24.31	0.1351	6.385	48.23	32.38	0.0007	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P	PLOT LINE
MEASURED:		21.68	0.5148	-2.219	46.08	26.44 0.0564	SOLID LINE
PREDICTED:		23.34	0.3926	-0.361	50.97	26.65 0.0465	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	26.65 0.0465	LONG DASH
	2	NO DATA					
	4	NO DATA					

MULTIPLE VEHICLE TEST 22 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P	PLOT LINE
MEASURED:	-	26.32	0.4221	-1.570	53.13	27.79 0.0680	SOLID LINE
PREDICTED:	+	32.48	0.5432	-5.625	56.21	25.80 0.2529	SQUARES
FROM TEST	1	NO DATA					
	2	32.48	0.5432	-5.625	56.21	25.80 0.2529	SHORT DASH
	4	NO DATA					

MULTIPLE VEHICLE TEST 22 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P	PLOT LINE
MEASURED:	-	31.12	0.2919	0.674	61.46	32.91 0.0293	SOLID LINE
PREDICTED:	++	42.12	0.8235	-15.337	60.67	24.88 0.7338	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	30.45 0.1878	LONG DASH
	2	24.20	0.8415	-8.232	42.48	33.07 0.0247	SHORT DASH
	4	41.04	0.8426	-15.345	59.31	25.13 0.7157	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P	PLOT LINE
MEASURED:		21.87	0.4745	-1.574	47.28	24.43 0.0711	SOLID LINE
PREDICTED:	+	27.66	1.1381	-14.550	42.51	17.13 0.7181	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	21.33 0.3350	LONG DASH
	2	NO DATA					
	4	24.78	0.9638	-10.346	41.48	20.73 0.3980	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P	PLOT LINE
MEASURED:		26.85	0.4367	-1.987	53.26	28.25 0.0729	SOLID LINE
PREDICTED:		27.14	0.5279	-3.878	51.23	27.25 0.1171	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	28.48 0.0529	LONG DASH
	2	NO DATA					
	4	24.15	0.4528	-1.707	50.13	28.54 0.0503	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P	PLOT LINE
MEASURED:		31.44	0.3347	-0.513	60.62	34.47 0.0350	SOLID LINE
PREDICTED:		31.18	0.3894	-1.825	58.89	34.21 0.0476	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	36.01 0.0025	LONG DASH
	2	26.49	0.6547	-6.024	47.86	34.47 0.0348	SHORT DASH
	4	29.01	0.3104	0.502	58.89	34.87 0.0202	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		35.38	0.2773	0.486	66.03	40.78	0.0164	SOLID LINE
PREDICTED:		37.73	0.1882	3.233	68.12	41.35	0.0058	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	41.48	0.0044	LONG DASH
	2	27.19	0.4062	-1.413	54.44	41.26	0.0069	SHORT DASH
	4	35.24	0.1767	3.903	64.97	41.62	0.0033	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		42.30	0.1753	3.337	71.94	42.82	0.0060	SOLID LINE
PREDICTED:		40.82	0.1769	3.403	70.57	42.88	0.0053	SQUARES
FROM TEST	1	38.05	0.1755	3.701	67.70	43.05	0.0037	LONG DASH
	2	37.64	0.1570	4.502	65.48	43.29	0.0021	SHORT DASH
	4	NO DATA						

MULTIPLE VEHICLE TEST 22 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		21.95	0.3117	1.569	51.81	23.38	0.0361	SOLID LINE
PREDICTED:		24.02	0.2915	1.719	54.37	23.71	0.0372	SQUARES
FROM TEST	1	22.08	0.2489	3.025	53.18	24.76	0.0169	LONG DASH
	2	7.89	0.3889	2.717	35.62	26.84	0.0020	SHORT DASH
	4	19.35	0.2617	3.064	50.28	25.03	0.0135	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		32.25	0.1921	3.609	62.82	29.48	0.0122	SOLID LINE
PREDICTED:		31.87	0.2150	2.869	63.00	29.29	0.0184	SQUARES
FROM TEST	1	29.18	0.2071	3.411	60.18	29.80	0.0115	LONG DASH
	2	8.39	0.2805	4.177	38.97	32.16	0.0006	SHORT DASH
	4	28.54	0.2048	3.550	59.49	29.93	0.0102	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 300. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		33.29	0.3474	-1.157	52.18	32.00	0.0637	SOLID LINE
PREDICTED:		36.57	0.2000	2.902	67.40	33.49	0.0147	SQUARES
FROM TEST	1	34.35	0.1841	3.701	54.54	34.01	0.0081	LONG DASH
	2	12.54	0.1852	5.681	42.78	35.98	0.0003	SHORT DASH
	4	32.66	0.1992	3.323	53.47	33.89	0.0093	DOTTED LINE

MULTIPLE VEHICLE TEST 22 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	34.97	0.2432	1.603	66.12	37.96	0.0152	SOLID LINE
PREDICTED:	++	45.51	0.1567	3.898	73.32	38.56	0.0073	SQUARES
FROM TEST	1	44.31	0.1376	4.907	68.81	39.23	0.0031	LONG DASH
	2	21.07	0.1534	5.930	48.42	40.63	0.0003	SHORT DASH
	4	39.36	0.1756	3.582	69.07	38.61	0.0069	DOTTED LINE

MULTIPLE VEHICLE TEST 23 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	17.72	0.5056	-1.065	42.35	18.52	0.1003	SOLID LINE
PREDICTED:	+	23.34	0.3926	-0.361	50.97	18.37	0.1212	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	18.37	0.1212	LONG DASH
	12	NO DATA						

MULTIPLE VEHICLE TEST 23 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	24.32	0.4720	-2.110	49.80	33.15	0.0241	SOLID LINE
PREDICTED:	+	29.51	0.8710	-10.993	47.38	31.34	0.1584	SQUARES
FROM TEST	1	NO DATA						
	12	29.51	0.8710	-10.993	47.38	31.34	0.1584	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	28.72	0.2974	0.881	58.93	34.56	0.0183	SOLID LINE
PREDICTED:	+	36.15	0.5235	-6.153	60.35	31.55	0.1972	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	31.93	0.1619	LONG DASH
	12	28.08	0.4355	-2.231	54.53	33.89	0.0379	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		20.67	0.6609	-4.211	41.92	21.11	0.1511	SOLID LINE
PREDICTED:	+	26.45	0.5352	-3.836	50.37	20.52	0.2313	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	19.39	0.4078	LONG DASH
	12	21.97	0.3653	0.444	50.37	22.01	0.0611	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		25.45	0.5075	-3.053	50.03	30.22	0.0553	SOLID LINE
PREDICTED:		28.99	0.3352	-0.117	58.22	30.35	0.0432	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	30.52	0.0376	LONG DASH
	12	27.33	0.2648	1.937	58.21	31.36	0.0172	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		29.35	0.2875	1.049	59.79	33.16	0.0220	SOLID LINE
PREDICTED:		31.74	0.3158	-0.068	61.49	32.67	0.0396	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	34.20	0.0045	LONG DASH
	12	31.54	0.3078	0.179	61.49	32.75	0.0359	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		34.22	0.2301	2.114	65.43	37.48	0.0124	SOLID LINE
PREDICTED:		38.22	0.1971	2.845	68.96	37.56	0.0109	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	37.85	0.0069	LONG DASH
	12	36.63	0.1841	3.492	66.81	37.85	0.0068	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 300. MHZ BW = 10. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED: +	27.56	0.2155	3.318	58.69	24.13	0.0201	SOLID LINE
PREDICTED:	23.25	0.2845	1.997	53.75	23.97	0.0310	SQUARES
FROM TEST 1	22.08	0.2489	3.025	53.18	24.76	0.0169	LONG DASH
12	17.12	0.2734	3.102	47.85	25.27	0.0108	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 300. MHZ BW = 30. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	29.33	0.2260	2.804	60.53	28.91	0.0175	SOLID LINE
PREDICTED:	30.10	0.2050	3.383	61.06	29.12	0.0131	SQUARES
FROM TEST 1	29.18	0.2071	3.411	60.18	29.18	0.0123	LONG DASH
12	23.11	0.2328	3.320	54.31	29.49	0.0088	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 300. MHZ BW = 100. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	36.80	0.1674	4.132	65.86	34.09	0.0068	SOLID LINE
PREDICTED:	35.30	0.1913	3.348	65.82	33.65	0.0107	SQUARES
FROM TEST 1	34.35	0.1841	3.701	64.54	33.90	0.0081	LONG DASH
12	28.30	0.1938	3.932	58.93	34.34	0.0049	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 300. MHZ BW = 300. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	42.86	0.1518	4.330	69.98	39.07	0.0047	SOLID LINE
PREDICTED:	44.83	0.1462	4.452	71.03	39.04	0.0046	SQUARES
FROM TEST 1	44.31	0.1376	4.907	68.81	39.35	0.0031	LONG DASH
12	35.50	0.1597	4.557	63.67	39.44	0.0027	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 900. MHZ BW = 100. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	18.35	0.1674	5.683	47.33	27.07	0.0020	SOLID LINE
PREDICTED:	22.08	0.1720	5.218	51.46	26.25	0.0037	SQUARES
FROM TEST 1	20.97	0.1601	5.706	49.18	26.57	0.0023	LONG DASH
12	15.77	0.1796	5.539	45.69	26.66	0.0020	SHORT DASH

MULTIPLE VEHICLE TEST 23 FREQ = 900. MHZ BW = 300. KHZ

	VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED: --	24.32	0.1518	5.737	51.45	32.02	0.0014	SOLID LINE
PREDICTED: ++	36.24	0.1227	6.172	56.56	31.94	0.0015	SQUARES
FROM TEST 1	35.97	0.1160	6.529	53.70	32.21	0.0010	LONG DASH
12	24.31	0.1351	6.385	48.23	32.38	0.0007	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 23. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	+	28.66	0.9171	-11.417	45.93	34.64	0.0611	SOLID LINE
PREDICTED:	-	23.34	0.3926	-0.361	50.97	35.44	0.0104	SQUARES
FROM TEST	1	23.34	0.3926	-0.361	50.97	35.44	0.0104	LONG DASH
	4	NO DATA						

MULTIPLE VEHICLE TEST 24 FREQ = 23. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:		28.71	0.4448	-2.568	0.00	0.00	0.0000	SOLID LINE
PREDICTED:	—	NO DATA						
FROM TEST	1	NO DATA						
	4	NO DATA						

MULTIPLE VEHICLE TEST 24 FREQ = 23. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	-	34.14	0.2443	1.669	65.28	40.93	0.0096	SOLID LINE
PREDICTED:	+	42.06	0.8188	-15.194	60.67	34.92	0.4434	SQUARES
FROM TEST	1	35.42	0.4969	-5.331	60.27	39.12	0.0641	LONG DASH
	4	41.04	0.8426	-15.345	59.31	35.24	0.4100	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 75. MHZ BW = 3. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	+	31.21	0.5684	-5.810	54.37	30.04	0.1535	SOLID LINE
PREDICTED:		27.66	1.1381	-14.550	42.51	29.94	0.1696	SQUARES
FROM TEST	1	24.54	0.8875	-9.077	42.19	30.78	0.0566	LONG DASH
	4	24.78	0.9638	-10.346	41.48	30.74	0.0610	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 75. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	++	35.31	0.3061	-0.354	65.31	35.59	0.0395	SOLID LINE
PREDICTED:	-	27.14	0.5279	-3.878	51.23	35.99	0.0260	SQUARES
FROM TEST	1	24.11	0.4670	-1.967	49.72	36.74	0.0102	LONG DASH
	4	24.15	0.4528	-1.707	50.13	36.74	0.0102	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 75. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	++	42.28	0.2265	1.320	73.49	38.27	0.0253	SOLID LINE
PREDICTED:	—	29.37	0.3244	0.090	58.89	38.71	0.0131	SQUARES
FROM TEST	1	18.62	0.4908	-1.062	43.62	40.19	0.0005	LONG DASH
	4	29.01	0.3104	0.502	58.89	38.80	0.0112	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 75. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT. AT P		PLOT LINE
MEASURED:	++	46.29	0.2219	1.046	77.47	44.42	0.0191	SOLID LINE
PREDICTED:	-	37.31	0.1955	2.997	67.99	45.46	0.0039	SQUARES
FROM TEST	1	33.21	0.2032	3.128	64.13	45.70	0.0025	LONG DASH
	4	35.24	0.1767	3.903	64.97	45.83	0.0020	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 75. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	++	51.54	0.1775	2.424	81.33	47.16	0.0102	SOLID LINE
PREDICTED:	--	38.05	0.1755	3.701	67.70	47.96	0.0021	SQUARES
FROM TEST	1	38.05	0.1755	3.701	67.79	47.96	0.0021	LONG DASH
	4	NO DATA						

MULTIPLE VEHICLE TEST 24 FREQ = 300. MHZ BW = 10. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		22.94	0.2935	1.830	53.24	24.65	0.0300	SOLID LINE
PREDICTED:		23.90	0.2849	1.894	54.39	25.02	0.0298	SQUARES
FROM TEST	1	22.08	0.2489	3.025	53.18	25.92	0.0147	LONG DASH
	4	19.35	0.2617	3.064	50.28	26.19	0.0116	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 300. MHZ BW = 30. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		27.86	0.2470	2.360	58.97	29.88	0.0178	SOLID LINE
PREDICTED:		31.85	0.2161	2.839	62.98	29.81	0.0177	SQUARES
FROM TEST	1	29.18	0.2071	3.411	60.18	30.28	0.0109	LONG DASH
	4	28.54	0.2048	3.550	59.49	30.39	0.0097	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 300. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		35.48	0.1943	3.217	66.13	34.38	0.0108	SOLID LINE
PREDICTED:		36.55	0.2002	2.899	67.39	34.10	0.0139	SQUARES
FROM TEST	1	34.35	0.1841	3.701	64.54	34.68	0.0075	LONG DASH
	4	32.66	0.1992	3.323	63.47	34.55	0.0087	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 300. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		40.20	0.1567	4.317	68.00	40.23	0.0038	SOLID LINE
PREDICTED:	+	45.50	0.1565	3.912	73.26	39.75	0.0065	SQUARES
FROM TEST	1	44.31	0.1376	4.907	68.81	40.41	0.0028	LONG DASH
	4	39.36	0.1756	3.582	69.02	39.81	0.0061	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 900. MHZ BW = 100. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:		20.44	0.2074	4.307	51.45	26.84	0.0060	SOLID LINE
PREDICTED:		22.24	0.1726	5.184	51.67	27.22	0.0035	SQUARES
FROM TEST	1	20.97	0.1601	5.706	49.18	27.60	0.0021	LONG DASH
	4	16.41	0.2695	3.280	47.21	26.56	0.0078	SHORT DASH

MULTIPLE VEHICLE TEST 24 FREQ = 900. MHZ BW = 300. KHZ

		VVRMS	WEIBULL M	10LOG(K)	DB AT P=.0001,	INTERSECT.	AT P	PLOT LINE
MEASURED:	-	28.19	0.1818	4.349	58.25	31.33	0.0053	SOLID LINE
PREDICTED:	+	36.27	0.1314	5.749	59.25	31.51	0.0024	SQUARES
FROM TEST	1	35.97	0.1160	6.529	53.70	32.02	0.0010	LONG DASH
	4	24.71	0.1763	4.845	54.42	31.32	0.0031	SHORT DASH

3.7 DATA PLOTS OF COMPARISON RESULTS OF MEASURED AND PREDICTED APD FOR MULTIPLE VEHICLES

This paragraph presents example data plots showing the straight-line approximations of measured and predicted APD for multiple vehicles. The plots were constructed from the computer printout data present in section 3.6. Squares are used to indicate the predicted composite. Crosses on the single-vehicle lines mark where the vehicle's line intersected its ambient line. The measured and predicted V_v for each test condition are listed at the top of the plot. The predicted V_v was summing the mean square values associated with the contributing vehicles. Plots are shown for the following tests:

Test Code	Number of Vehicles Tested
16	12
17	6
18	6
19	6
20	3
21	3
22	3
23	2
24	2

The frequency (FR) and bandwidth (BW) have also been coded as follows:

Frequency (FR)

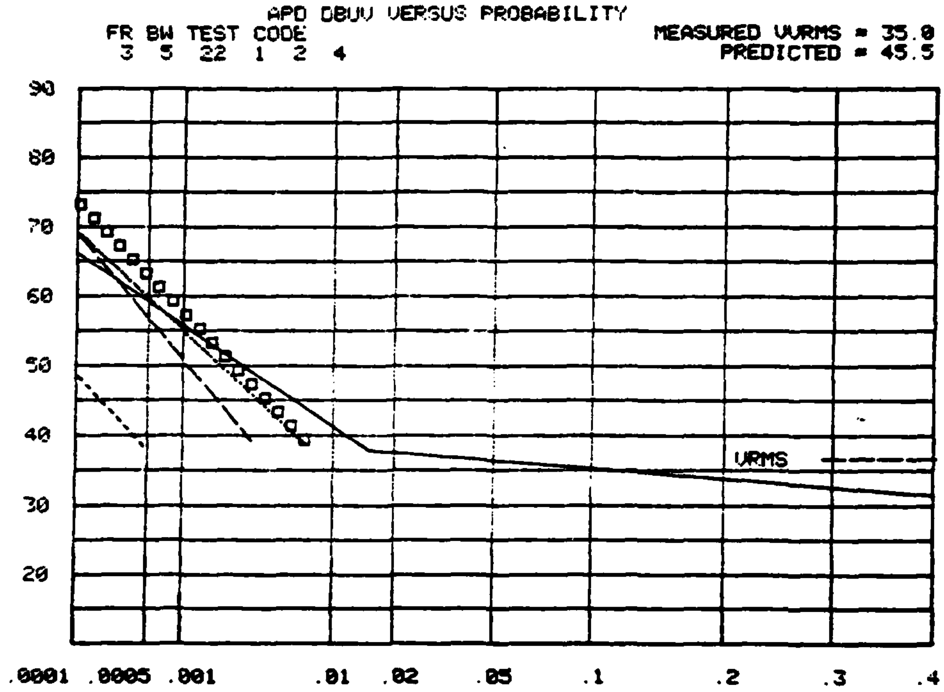
Code	Value
1	23 MHz
2	75 MHz
3	300 MHz
4	900 MHz

Bandwidth (BW)

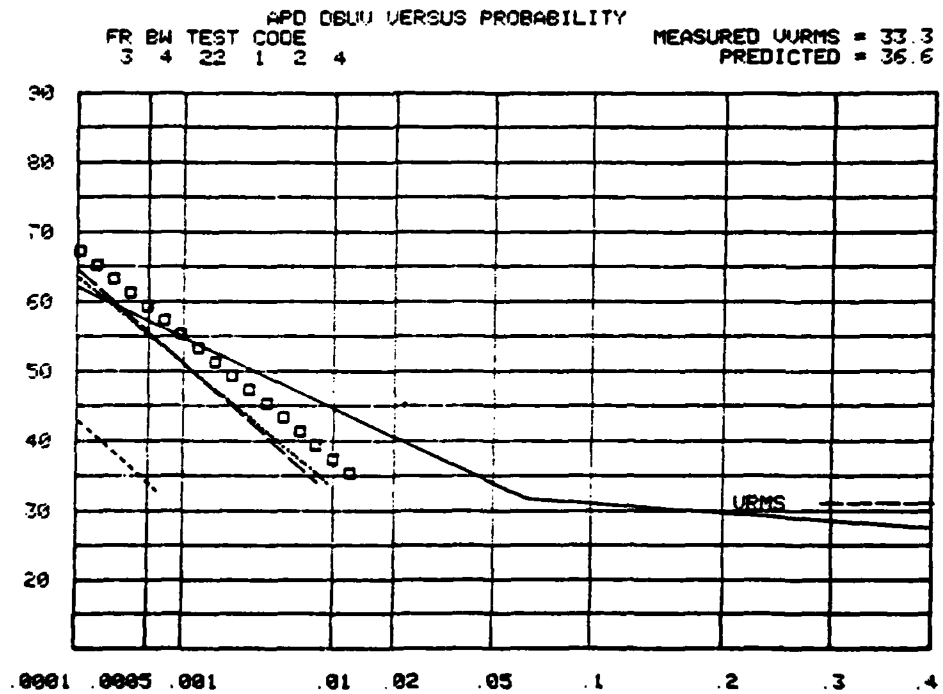
Code	Value
1	3 KH
2	10 KHz
3	30 KHz
4	100 KHz
5	300 KHz

The measured value of V_{rms} for the multiple-vehicle test is indicated so that the ordinates can be easily rescaled from dB(μV) to dB re rms.

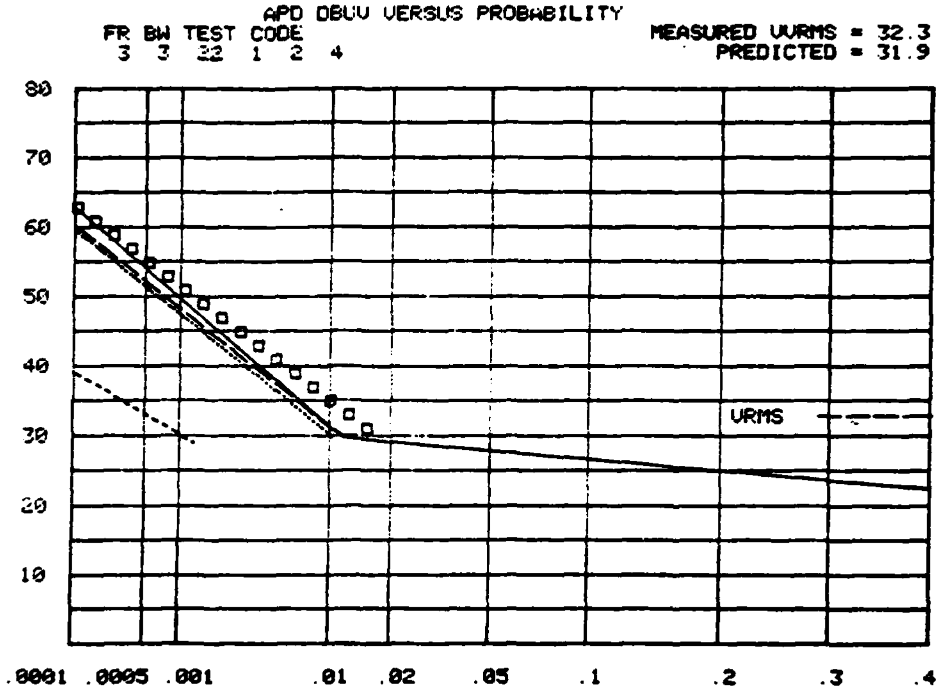
The sample plots include a plot for test code 20 at 75 MHz, which, as discussed in 3.1.4.2, is considered to be invalid due to excessive attenuation between the antenna and the NATE receiver input.

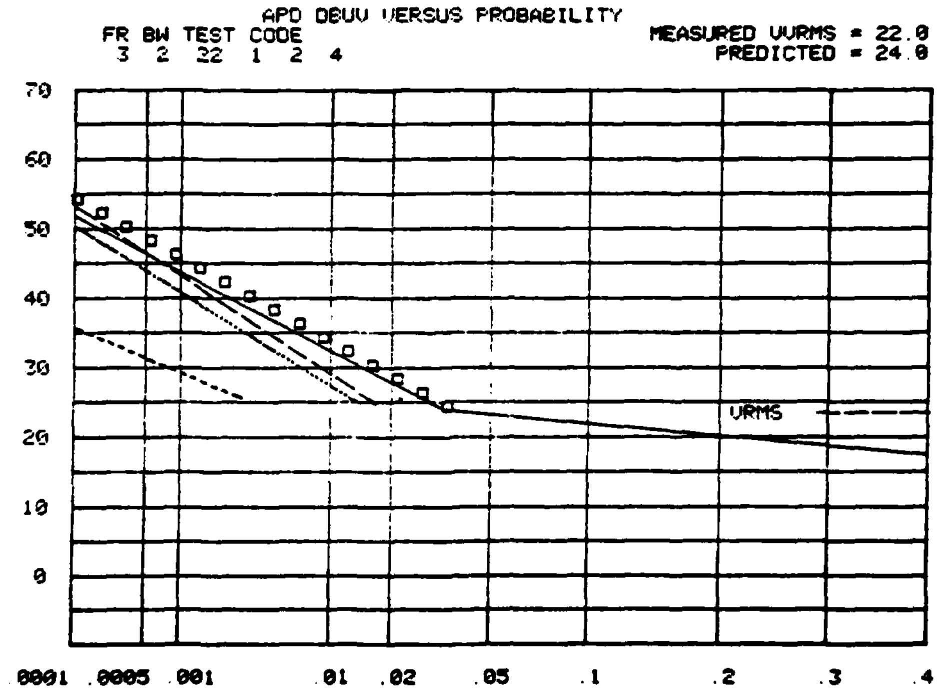


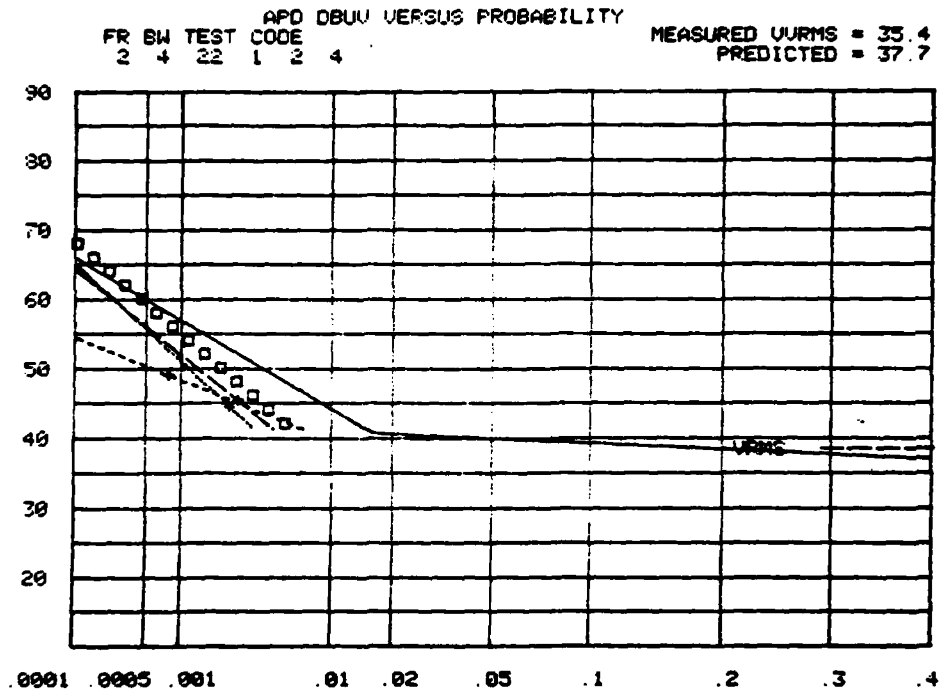
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 22 1 2 4
MEASURED VVRMS = 35.0
PREDICTED = 45.5
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

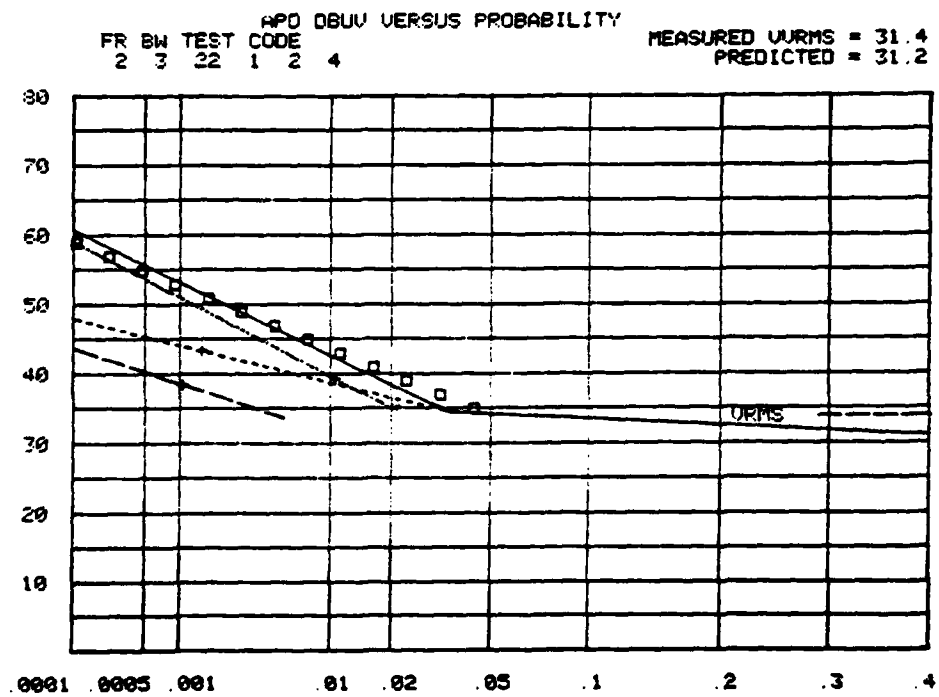


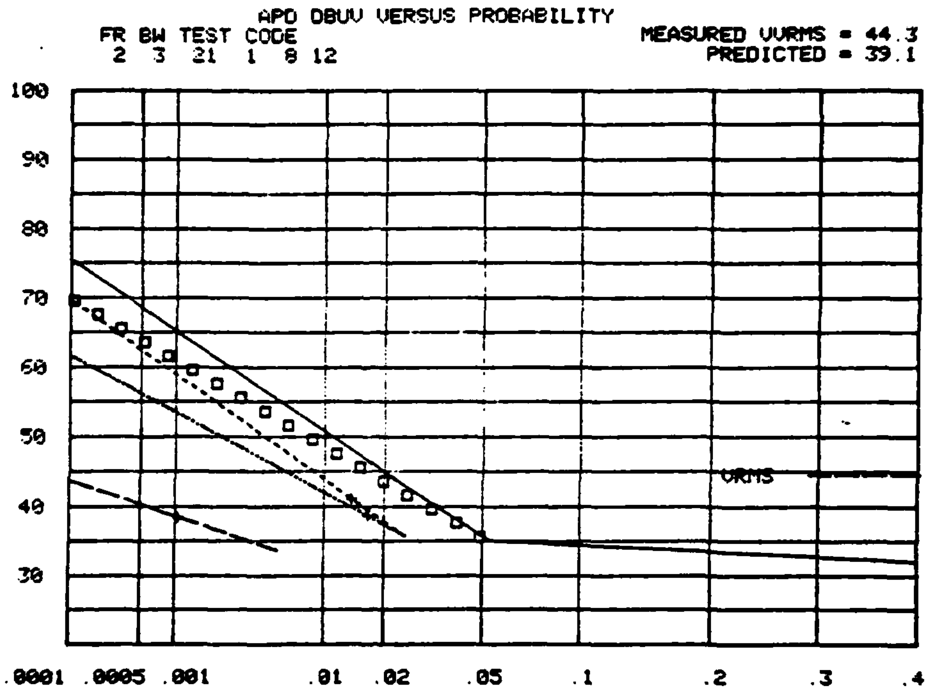
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 4 22 1 2 4
MEASURED VVRMS = 33.3
PREDICTED = 36.6
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

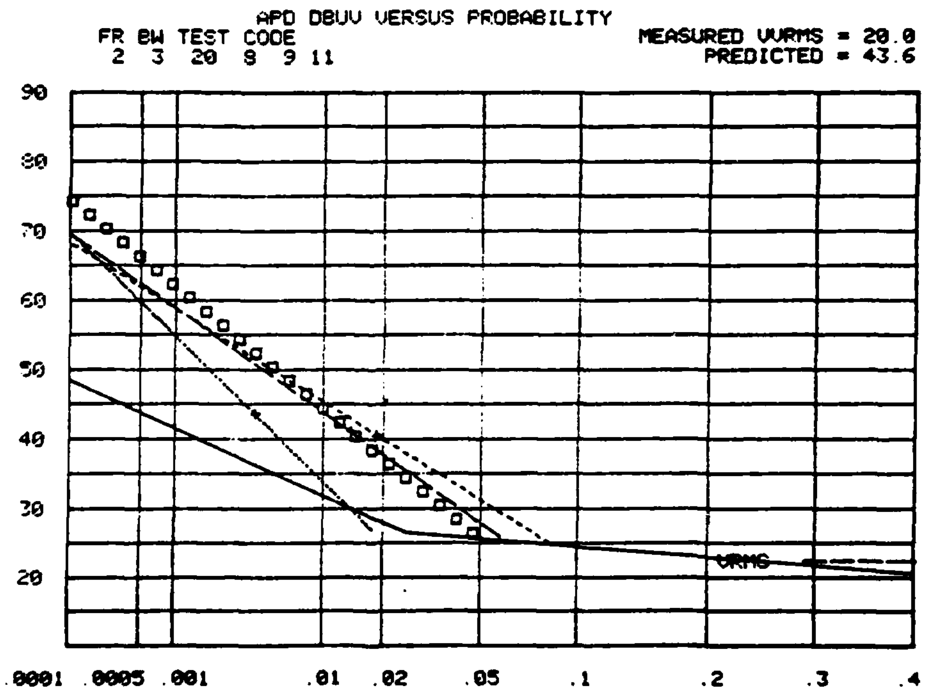

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 3 22 1 2 4
MEASURED VVRMS = 32.3
PREDICTED = 31.9
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

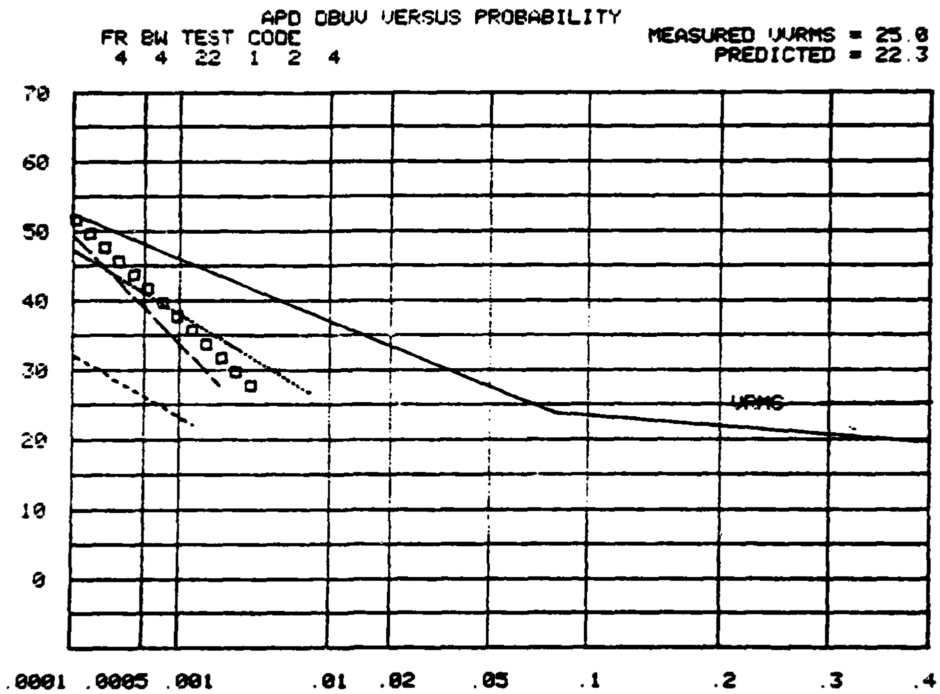

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 2 22 1 2 4
MEASURED VVRMS = 22.0
PREDICTED = 24.0
70
60
50
40
30
20
10
0
VRMS
0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

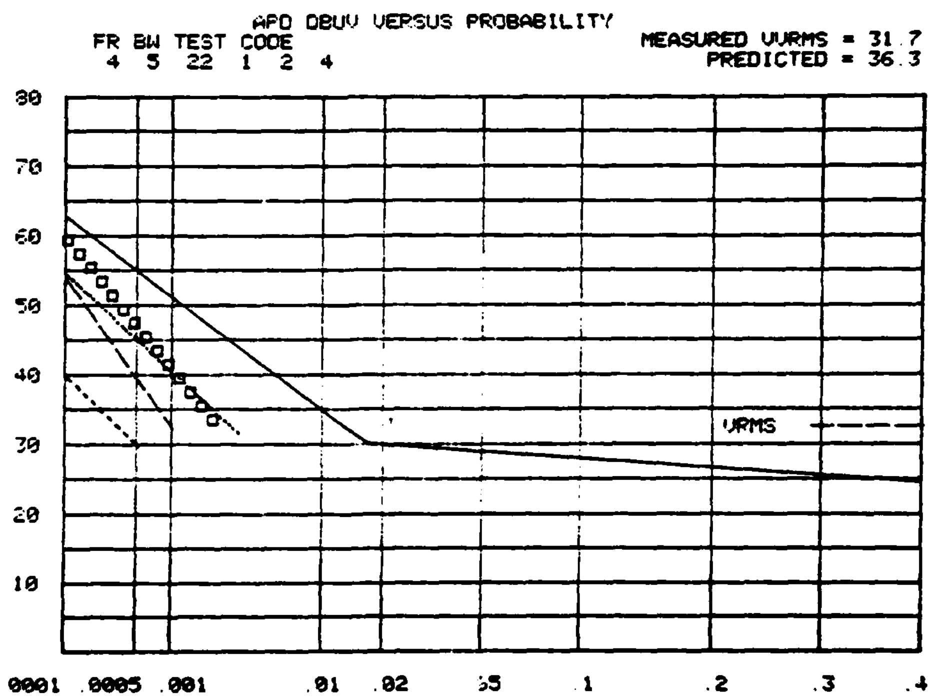

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 4 22 1 2 4
MEASURED VVRMS = 35.4
PREDICTED = 37.7
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

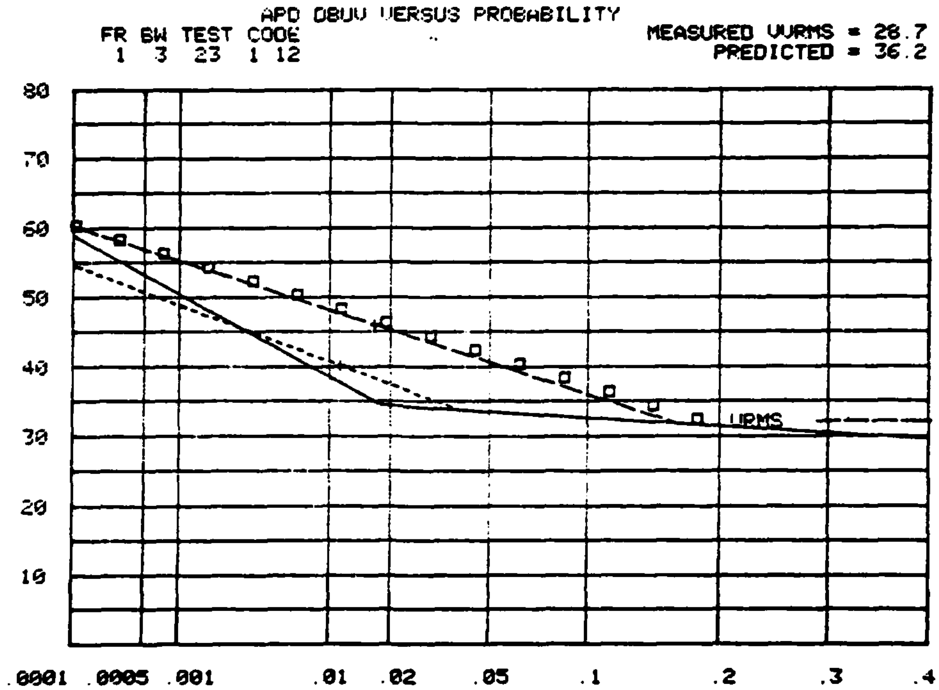

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 3 22 1 2 4
MEASURED VVRMS = 31.4
PREDICTED = 31.2
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

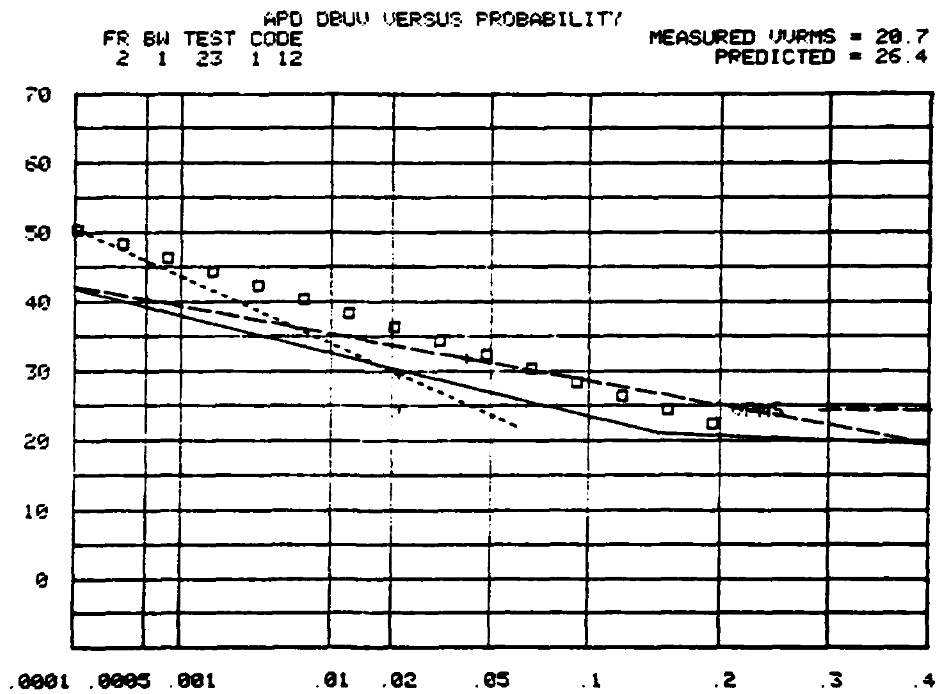

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 3 21 1 8 12
MEASURED VVRMS = 44.3
PREDICTED = 39.1
100
90
80
70
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

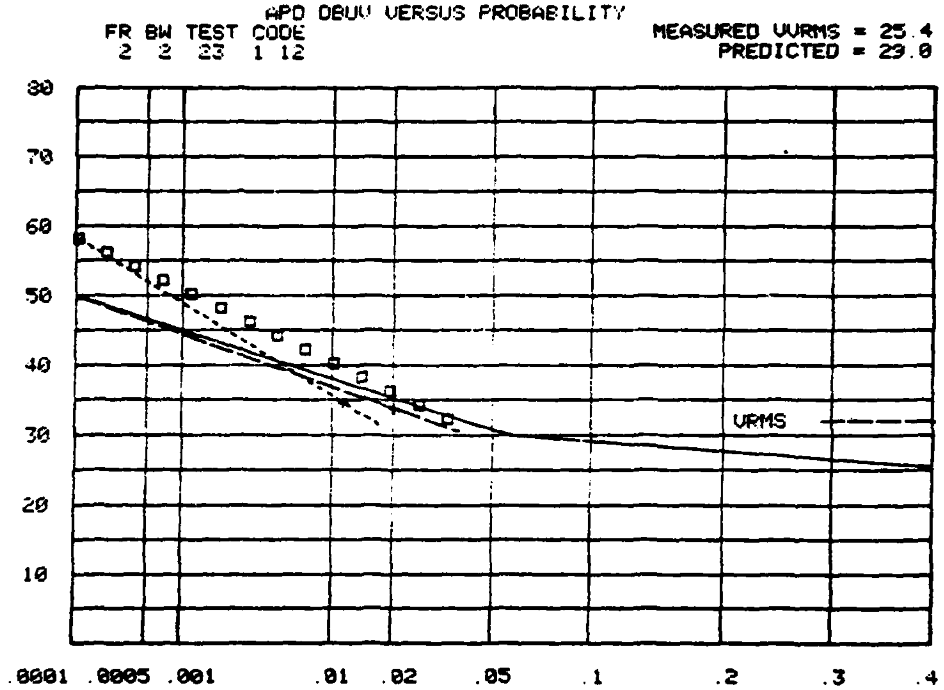

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 3 20 8 9 11
MEASURED VVRMS = 20.0
PREDICTED = 43.6
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

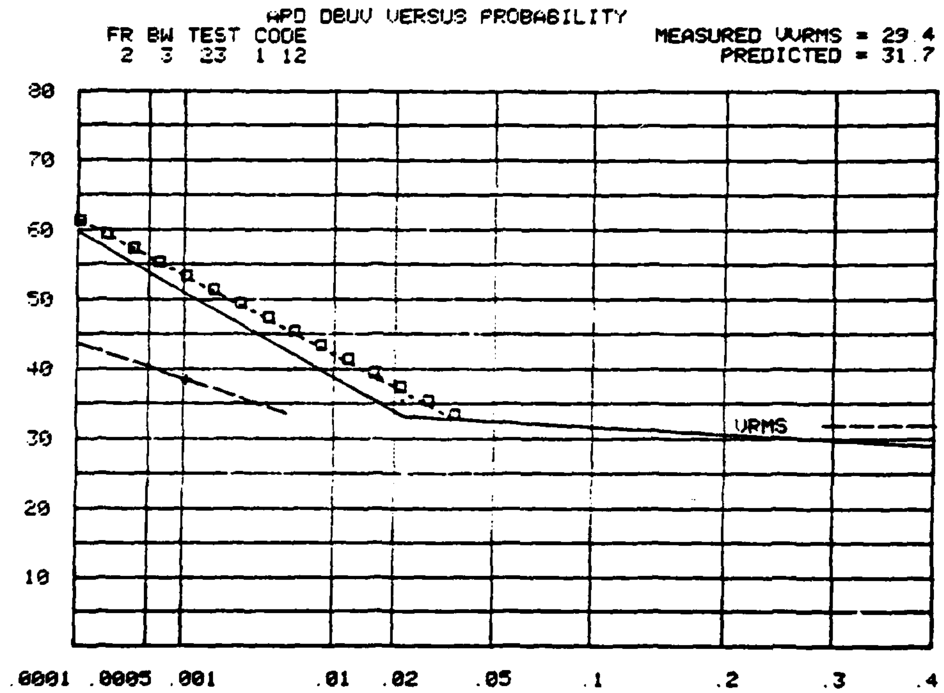

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 4 22 1 2 4
MEASURED VVRMS = 25.0
PREDICTED = 22.3
70
60
50
40
30
20
10
0
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

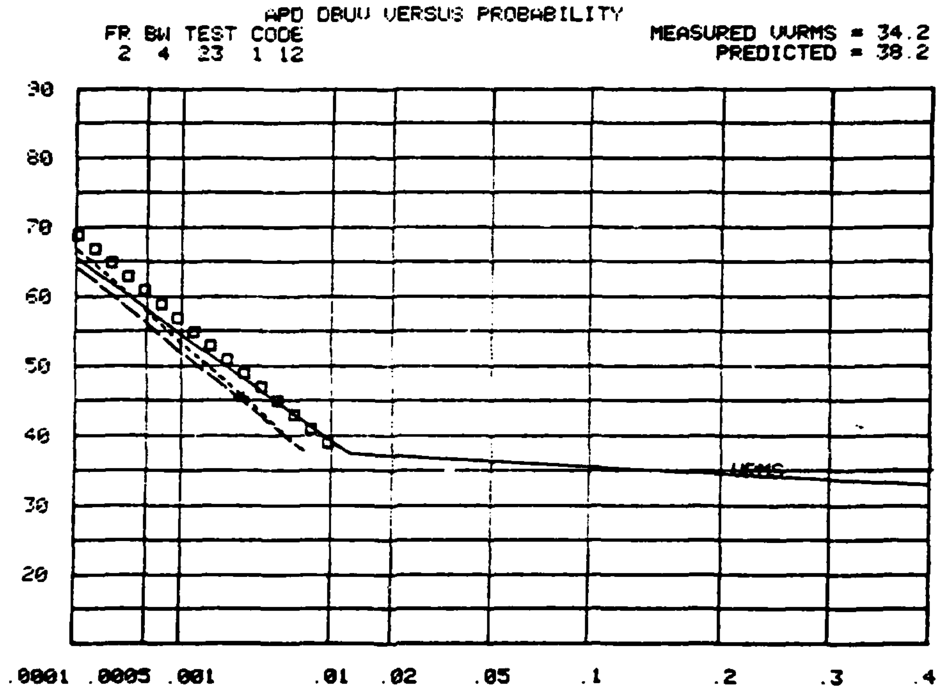

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 22 1 2 4
MEASURED VVRMS = 31.7
PREDICTED = 36.3
80
70
60
50
40
30
20
10
VRMS
0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 3 23 1 12
MEASURED VVRMS = 28.7
PREDICTED = 36.2
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

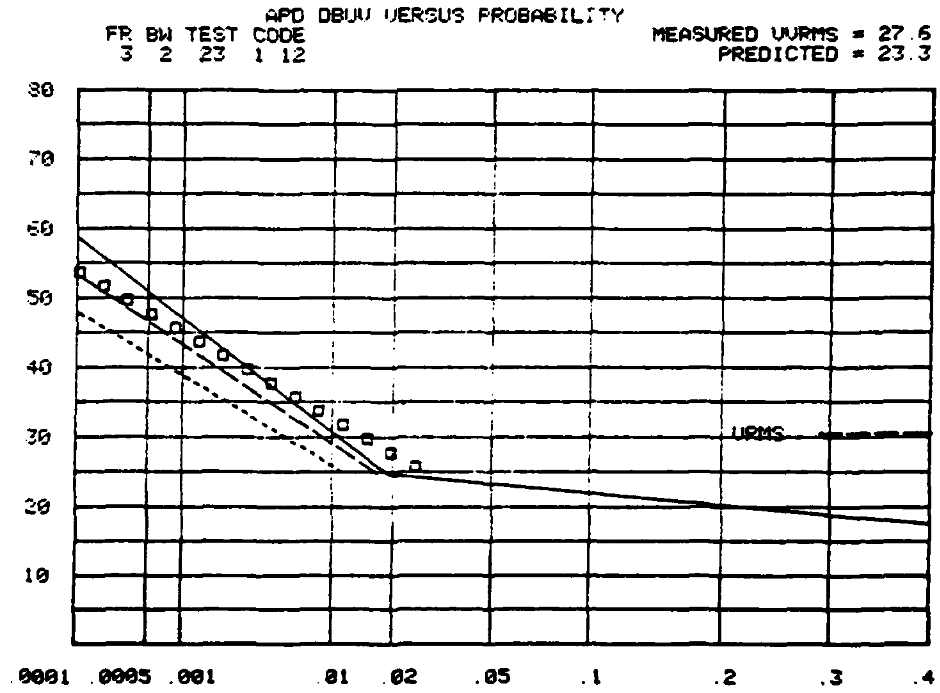

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 1 23 1 12
MEASURED VVRMS = 20.7
PREDICTED = 26.4
70
60
50
40
30
20
10
0
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 2 23 1 12
MEASURED VVRMS = 25.4
PREDICTED = 29.0
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

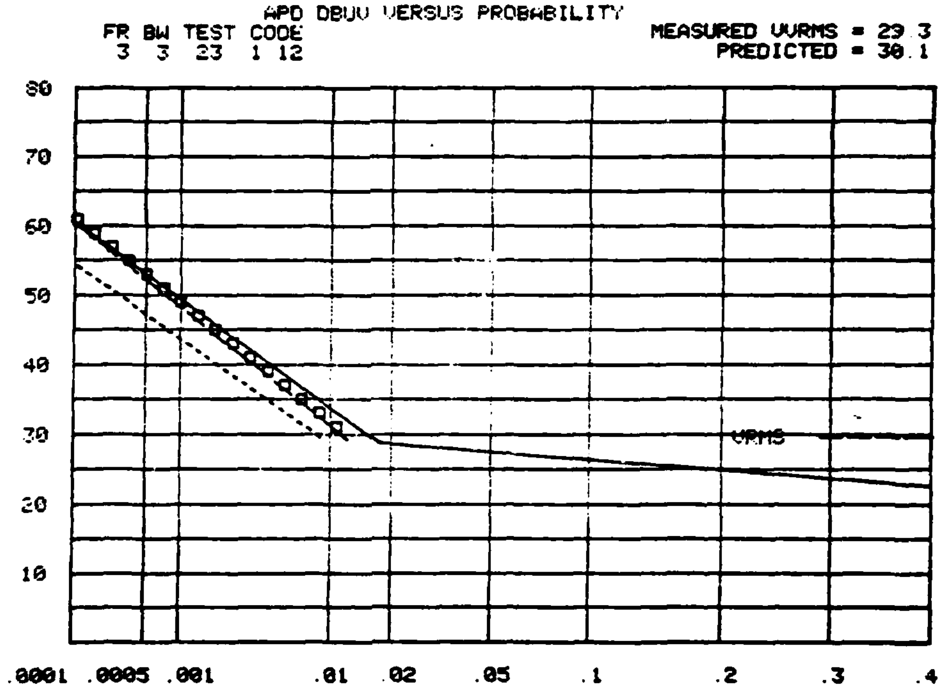

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 3 23 1 12
MEASURED VVRMS = 29.4
PREDICTED = 31.7
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



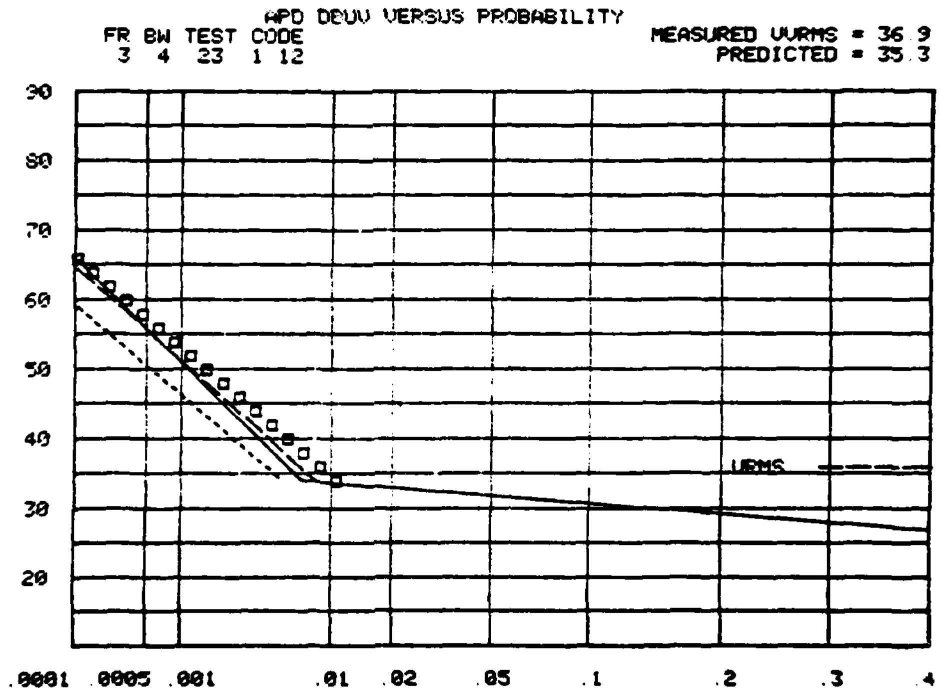
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 4 23 1 12
MEASURED VVRMS = 34.2
PREDICTED = 38.2
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



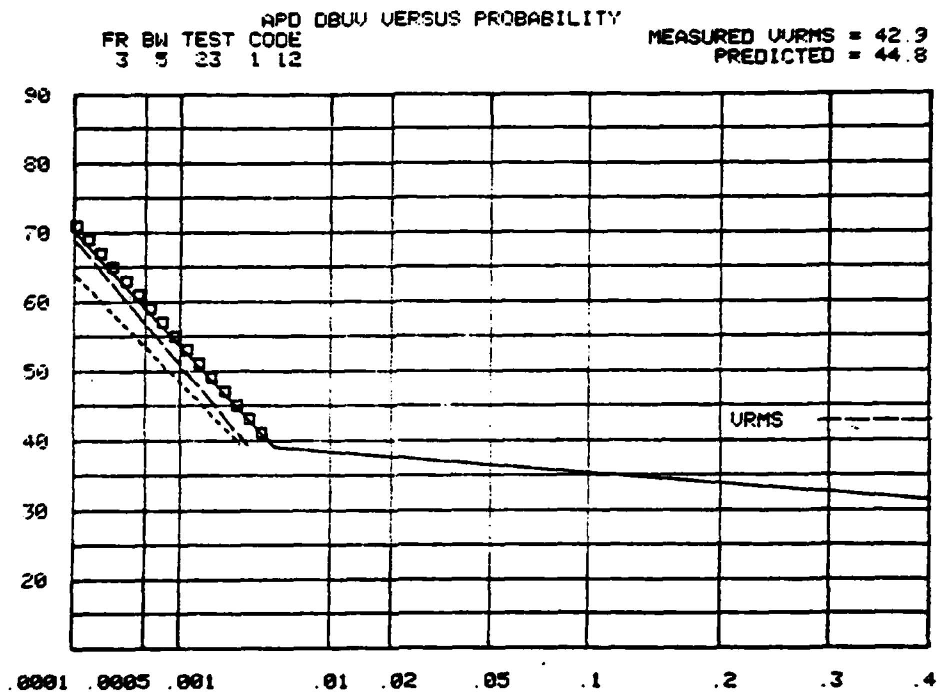
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 2 23 1 12
MEASURED VVRMS = 27.6
PREDICTED = 23.3
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

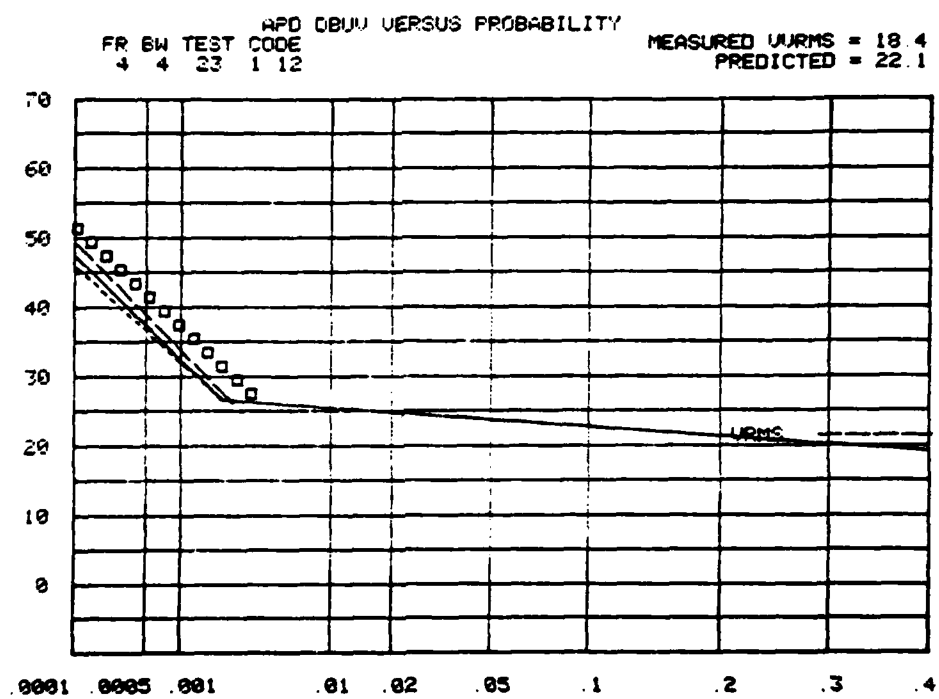


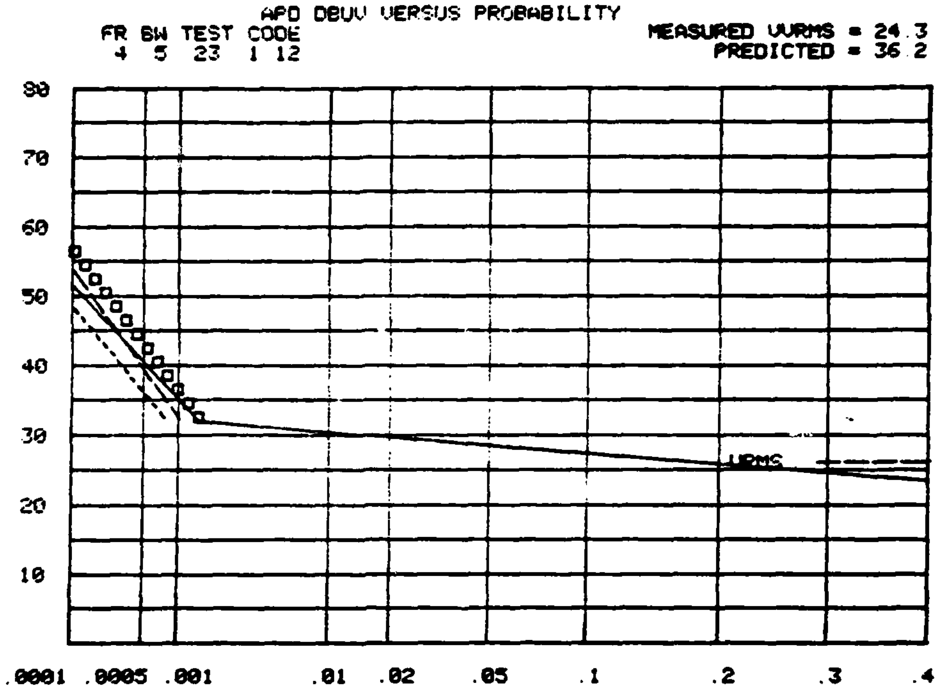
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 3 23 1 12
MEASURED VVRMS = 29.3
PREDICTED = 30.1
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

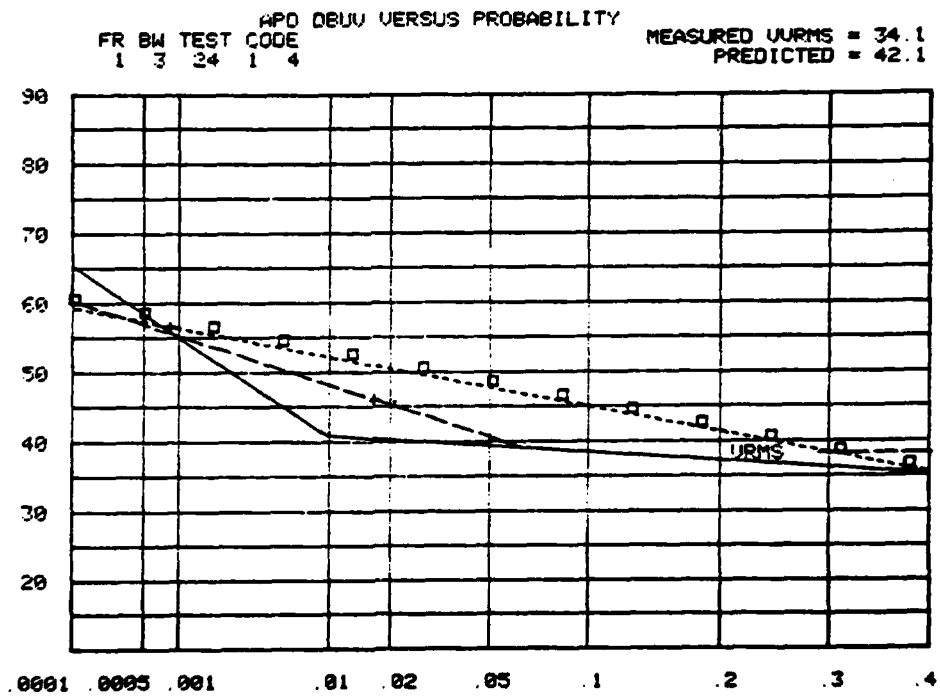


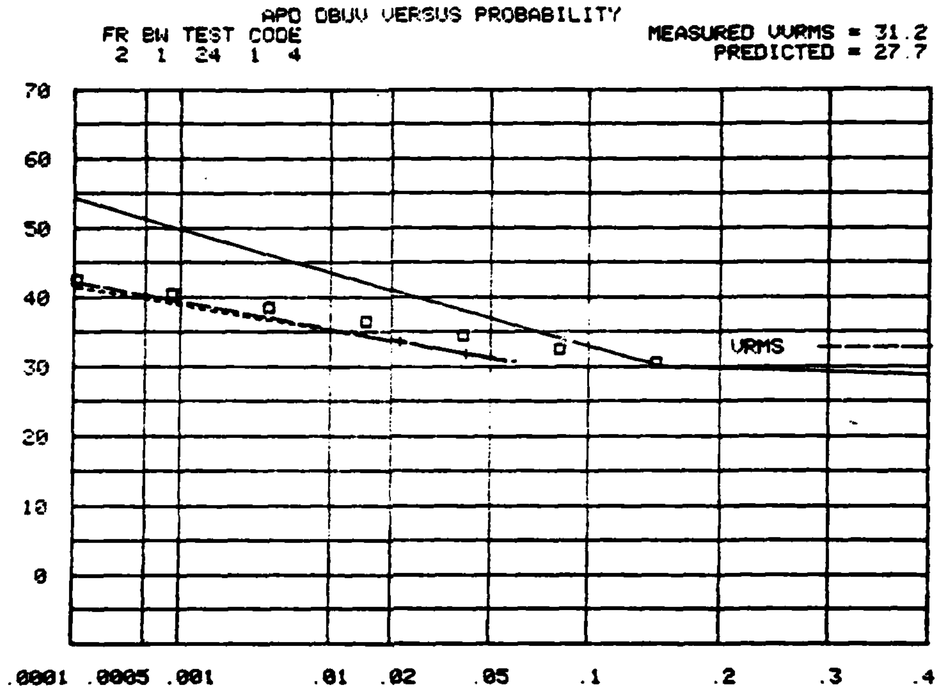
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 4 23 1 12
MEASURED VVRMS = 36.9
PREDICTED = 35.3
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

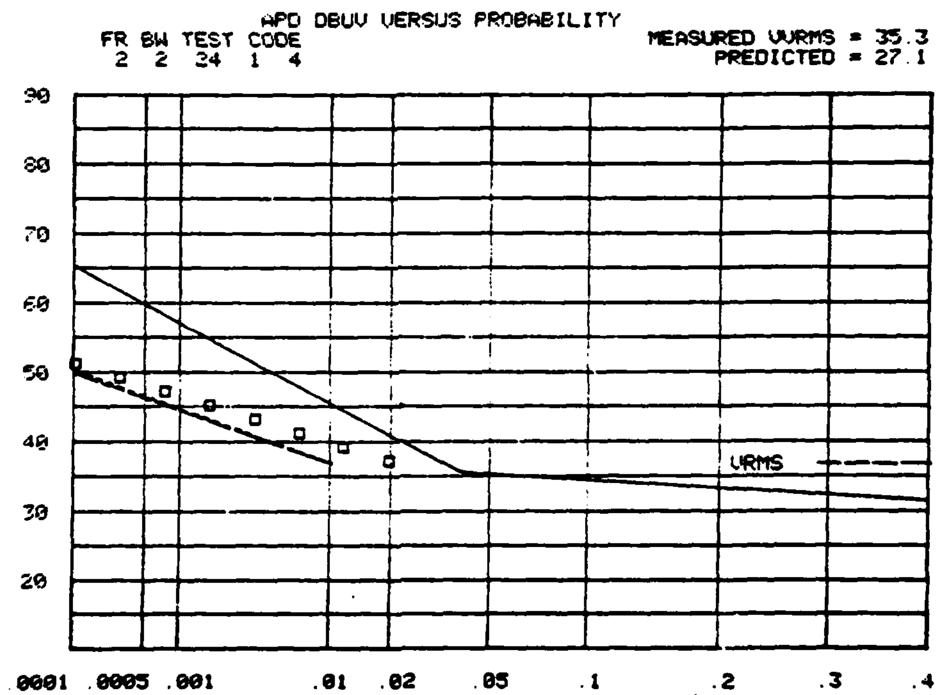

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 23 1 12
MEASURED VVRMS = 42.9
PREDICTED = 44.8
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

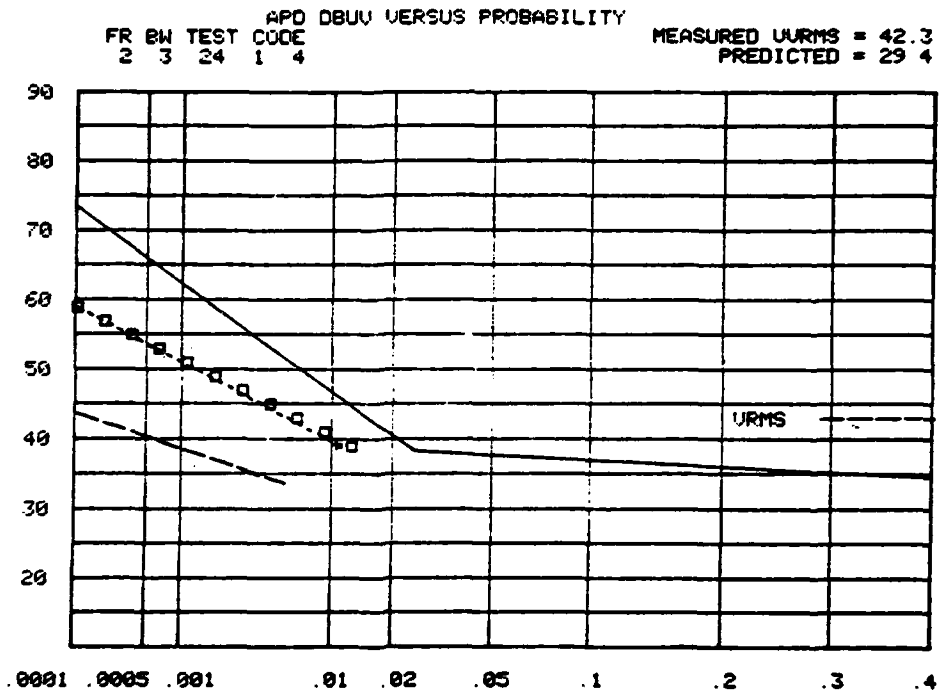

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 4 23 1 12
MEASURED VVRMS = 18.4
PREDICTED = 22.1
70
60
50
40
30
20
10
0
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 23 1 12
MEASURED VVRMS = 24.3
PREDICTED = 36.2
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

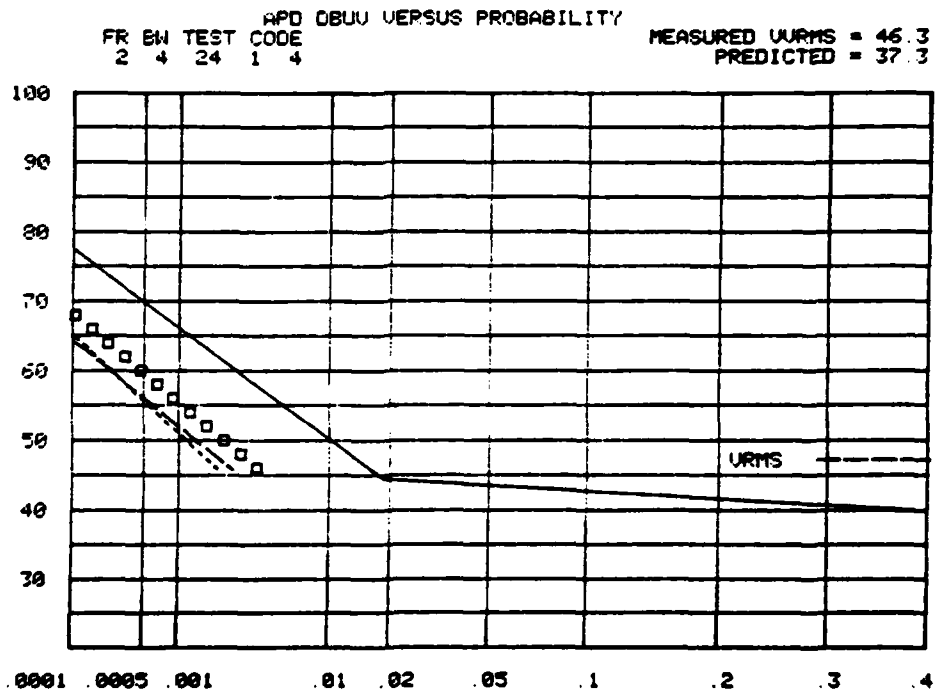

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
1 3 24 1 4
MEASURED VVRMS = 34.1
PREDICTED = 42.1
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 1 24 1 4
MEASURED VVRMS = 31.2
PREDICTED = 27.7
70
60
50
40
30
20
10
0
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

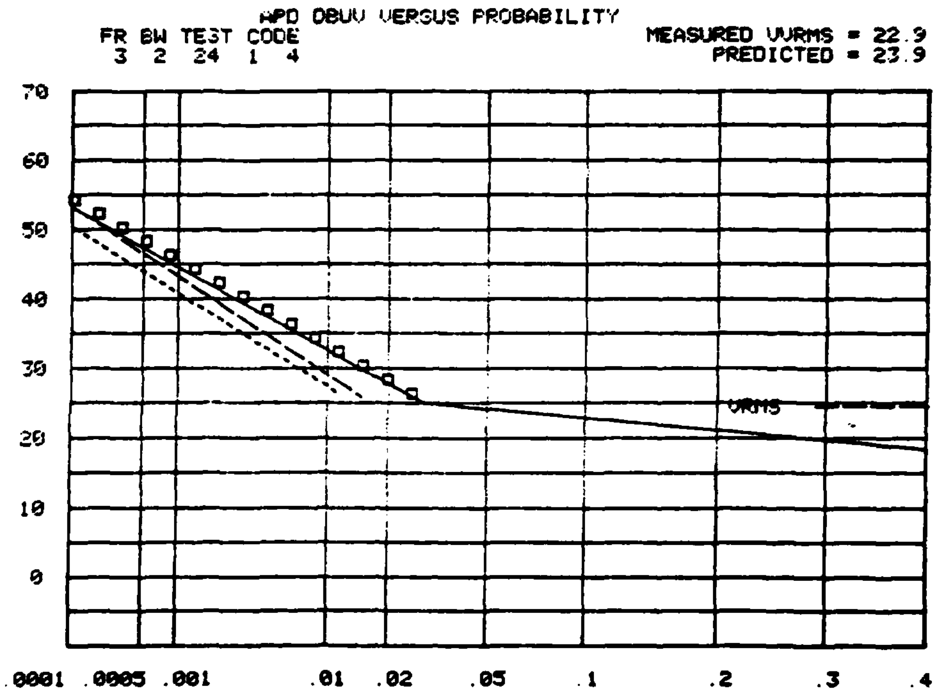

APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 2 24 1 4
MEASURED VVRMS = 35.3
PREDICTED = 27.1
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



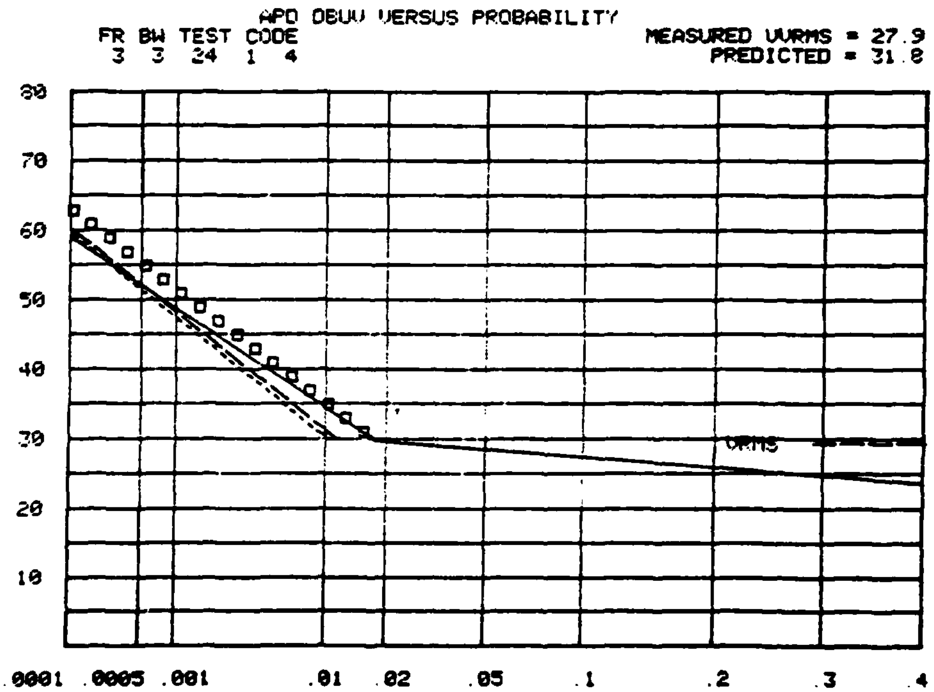
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 3 24 1 4
MEASURED VVRMS = 42.3
PREDICTED = 29 4
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



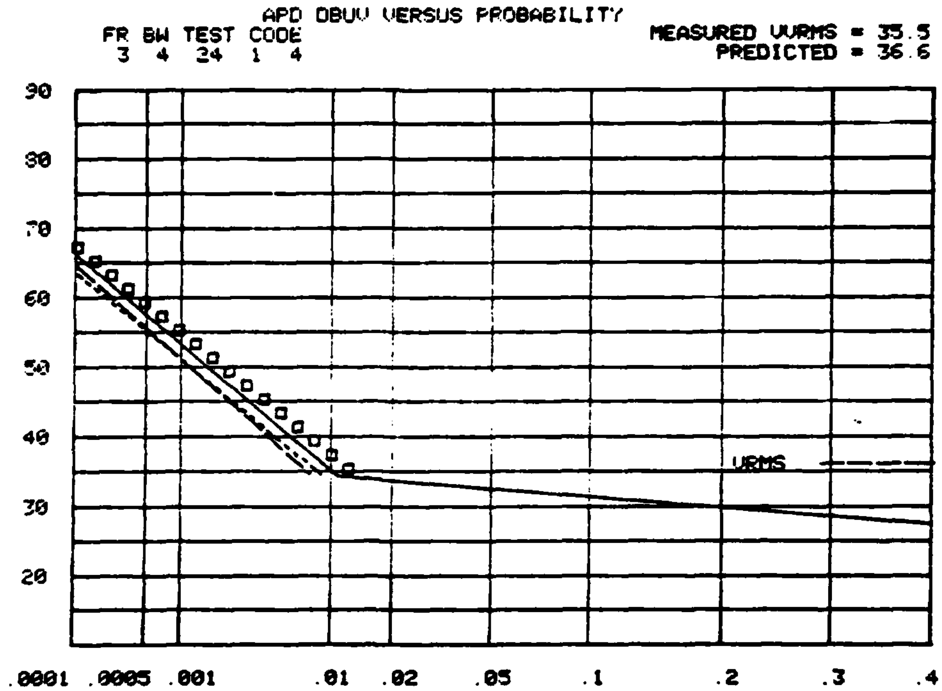
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
2 4 24 1 4
MEASURED VVRMS = 46.3
PREDICTED = 37.3
100
90
80
70
60
50
40
30
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

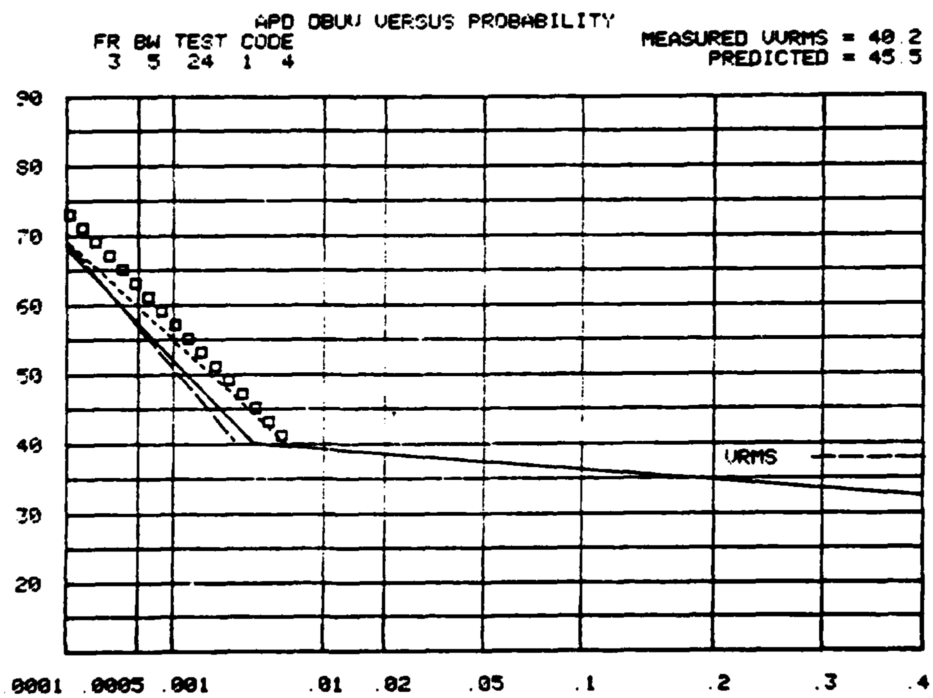


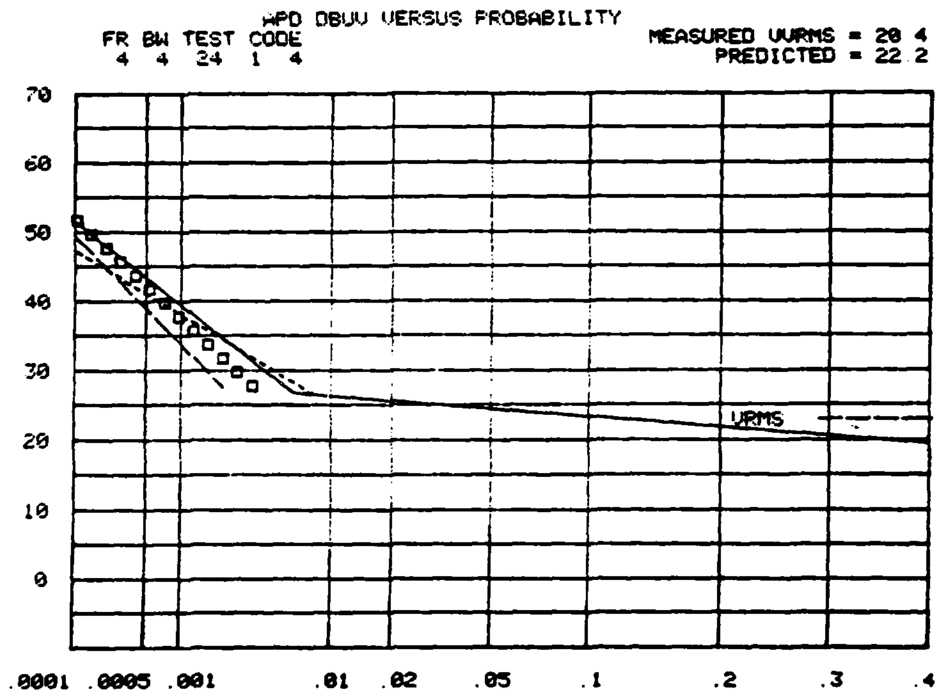
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 2 24 1 4
MEASURED VVRMS = 22.9
PREDICTED = 23.9
70
60
50
40
30
20
10
0
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



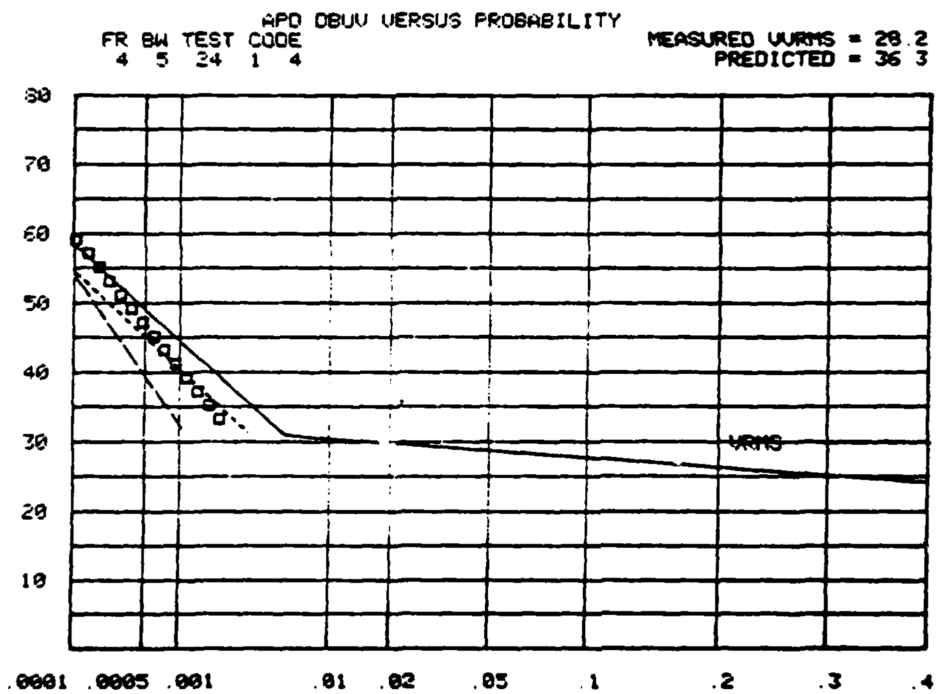
APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 3 24 1 4
MEASURED VVRMS = 27.9
PREDICTED = 31.8
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 4 24 1 4
MEASURED VVRMS = 35.5
PREDICTED = 36.6
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4


APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
3 5 24 1 4
MEASURED VVRMS = 40.2
PREDICTED = 45.5
90
80
70
60
50
40
30
20
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 4 24 1 4
MEASURED VVRMS = 20.4
PREDICTED = 22.2
70
60
50
40
30
20
10
0
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4



APD DBUV VERSUS PROBABILITY
FR BW TEST CODE
4 5 24 1 4
MEASURED VVRMS = 28.2
PREDICTED = 36.3
80
70
60
50
40
30
20
10
VRMS
.0001 .0005 .001 .01 .02 .05 .1 .2 .3 .4

3.8 DATA PLOTS OF REGRESSIONS OF V_p, V_{av}, V_{rms}, V_a, AND V_v FOR SINGLE VEHICLES

The raw data and estimated regression links for the various noise parameters versus log b are presented in the following computer-generated plots. The parameter names used by the computer for plot labeling are related to symbols used in the text as follows:

VP = V_p

VT = V_{rms}

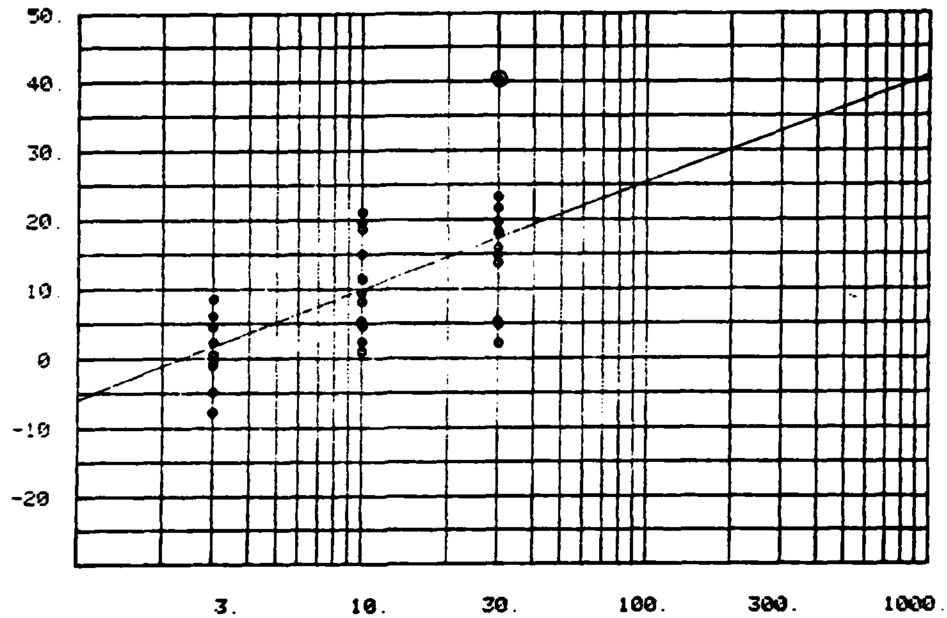
SA = V_{av}

VA = V_a

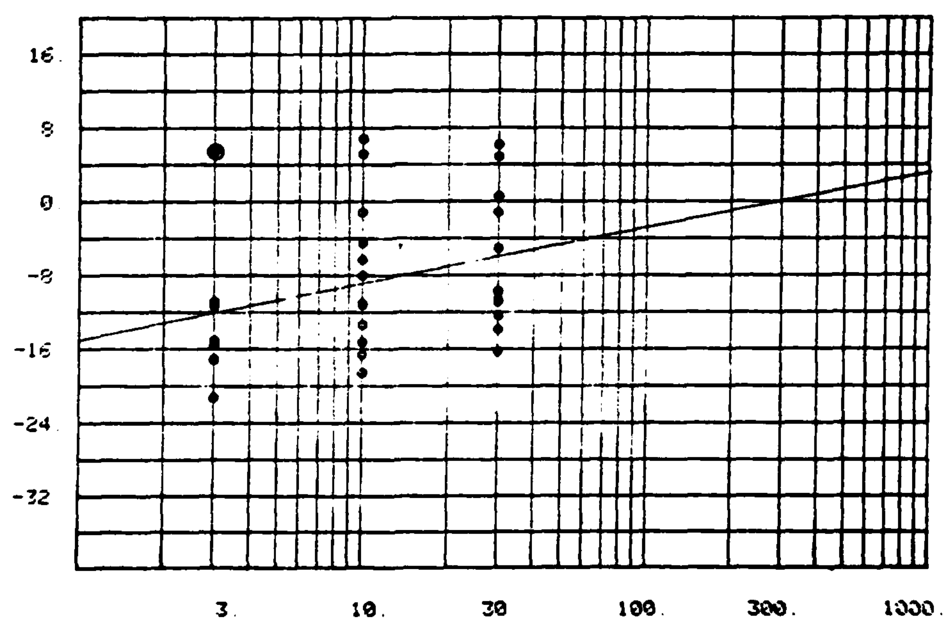
VV = V_v

Data points which were detected as being probable gross errors are flagged by a larger circle enclosing the point.

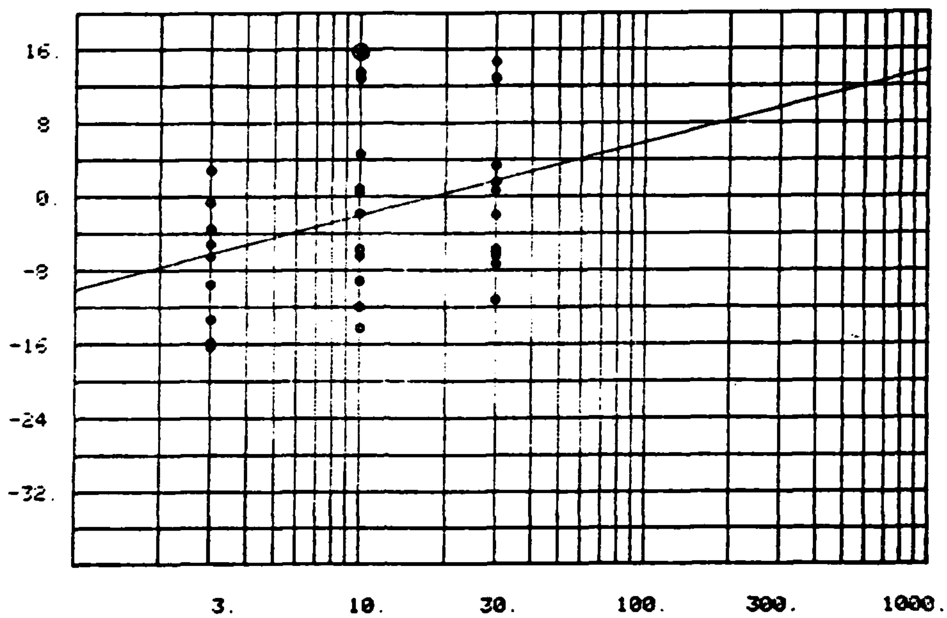
VP VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 1



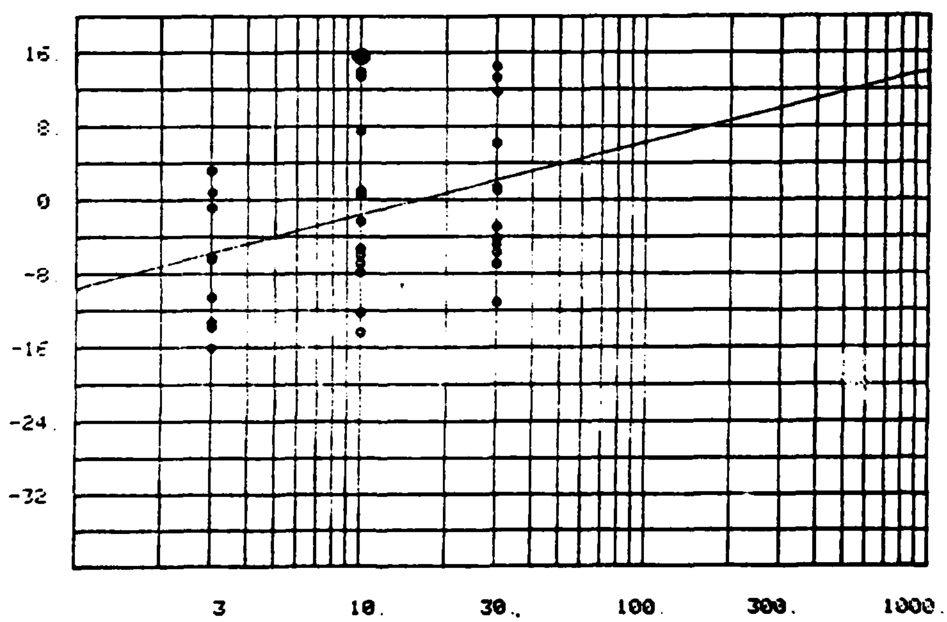
VV VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 1

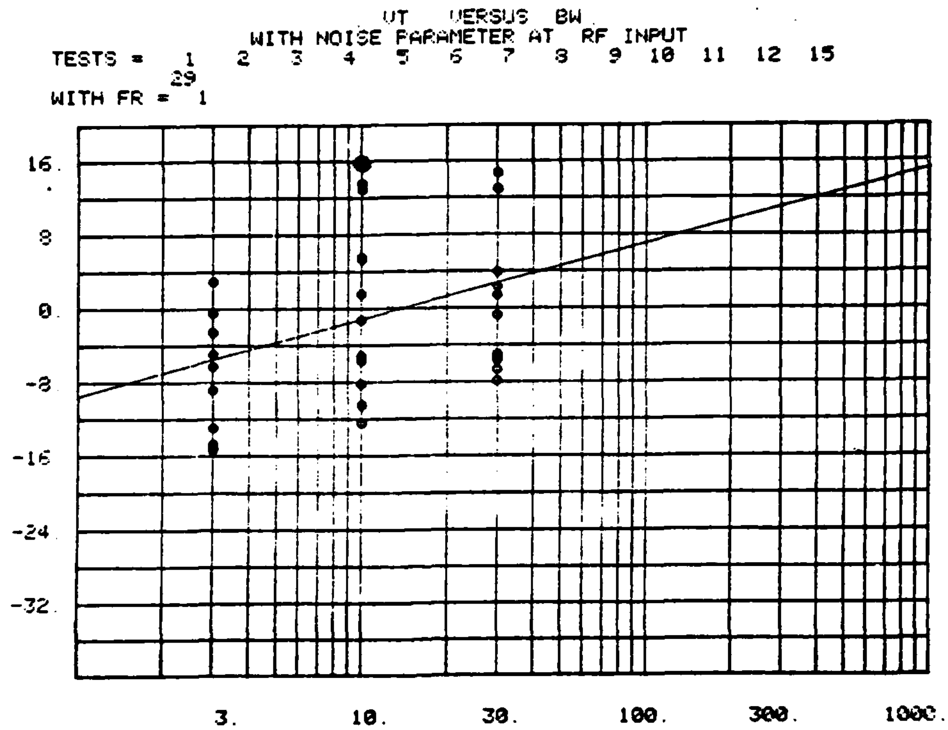


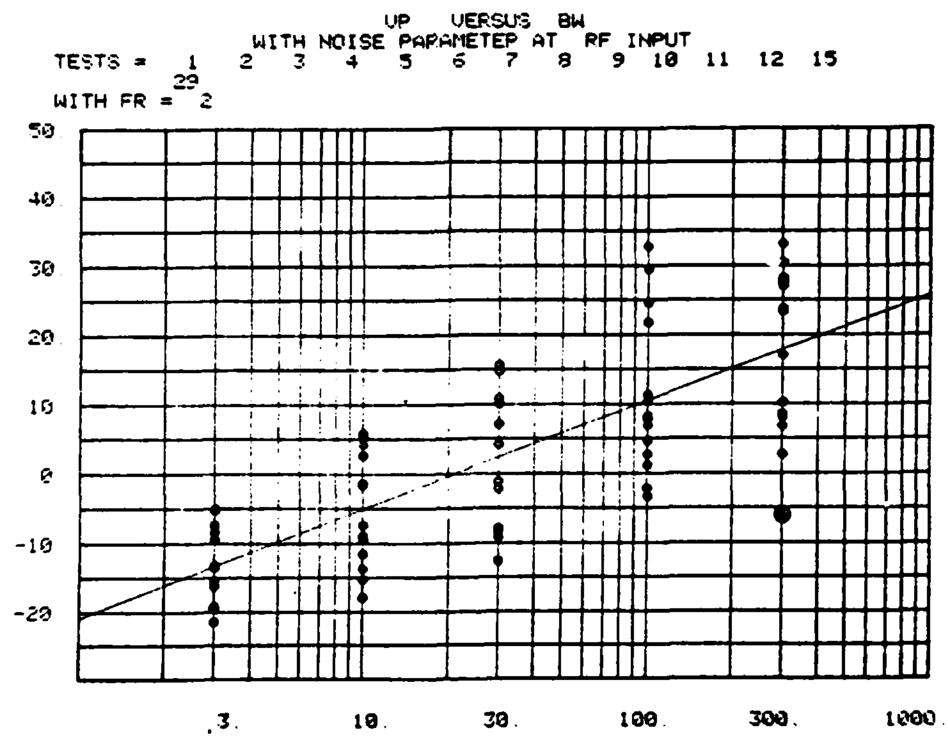
VA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 1

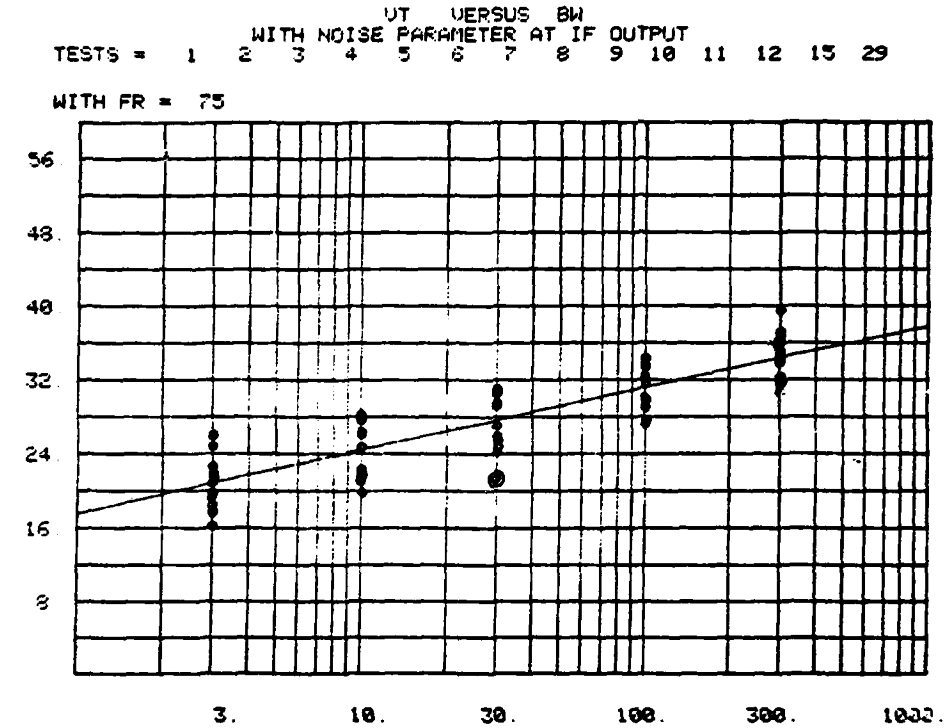


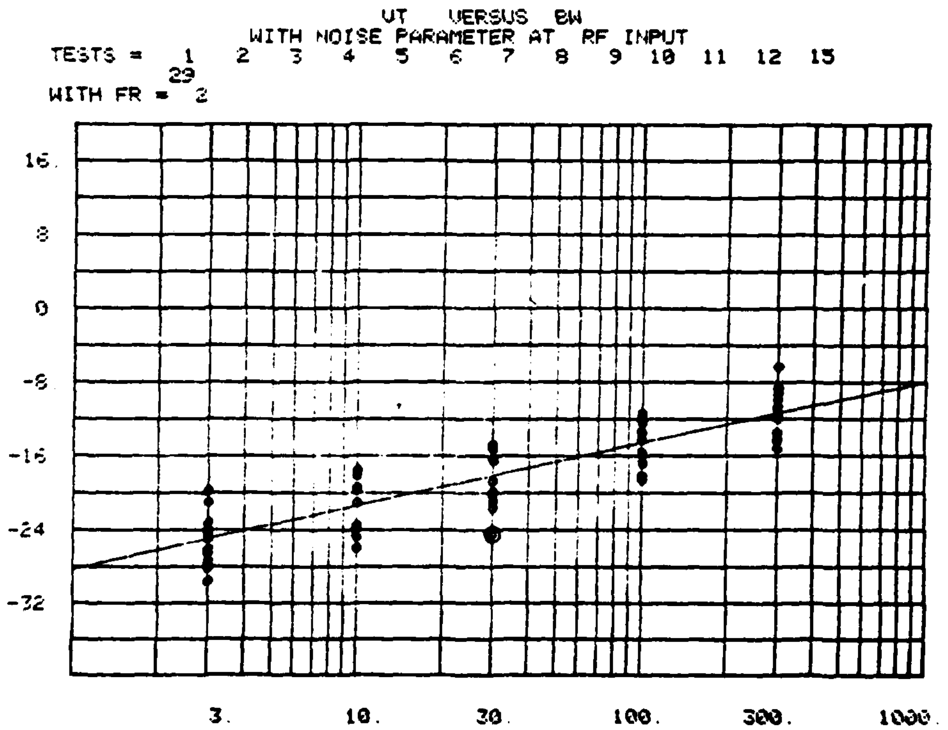
SA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 1



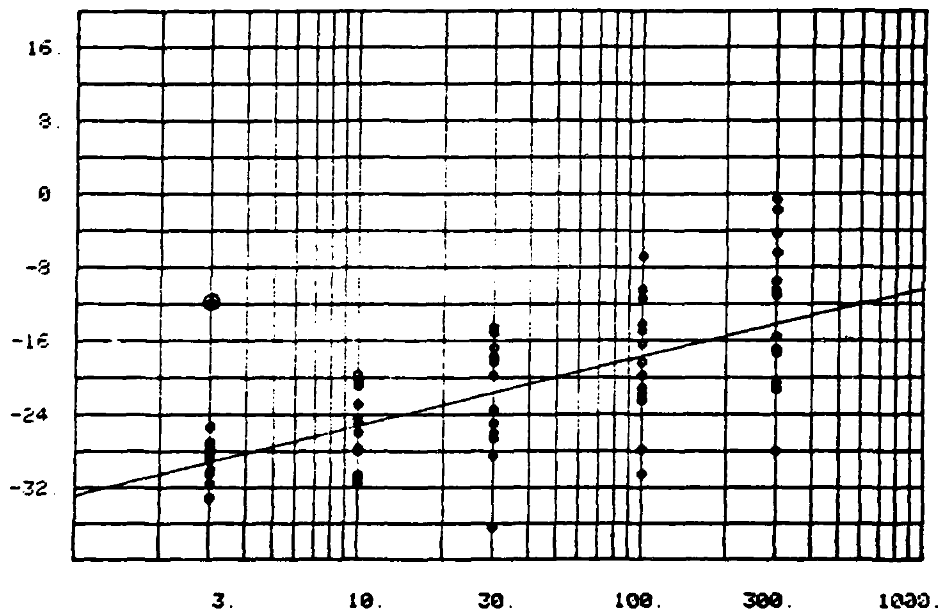

VT VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 1
16.
8
0.
-8
-16
-24
-32.
3.
10.
30.
100.
300.
1000.


VP VERSUS BW
WITH NOISE PARAMETEP AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 2
50
40
30
20
10
0
-10
-20
3.
10.
30.
100.
300.
1000.

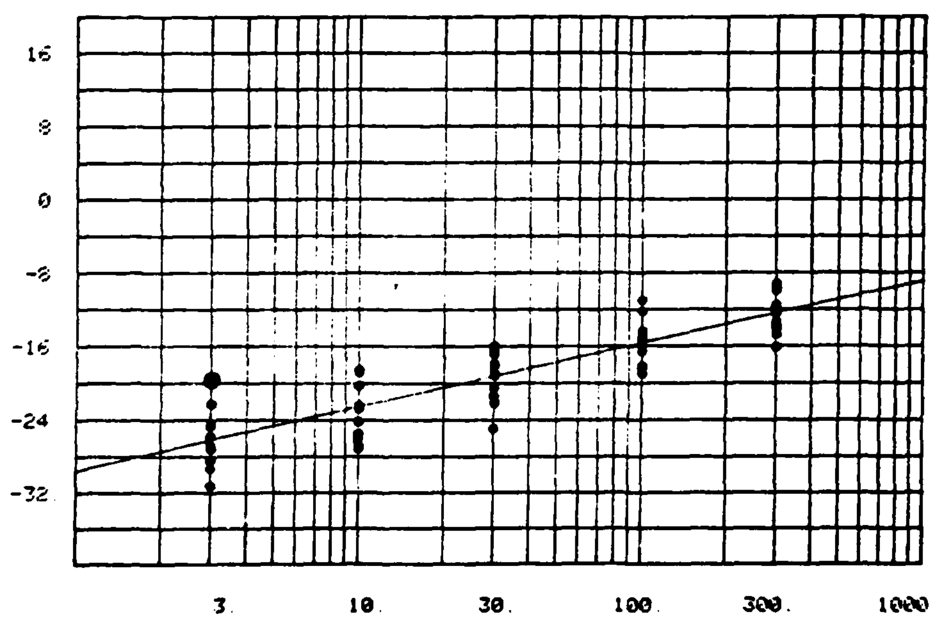

VT VERSUS BW
WITH NOISE PARAMETER AT IF OUTPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 75
56
48
40
32
24
16
8
3.
10.
30.
100.
300.
1000.

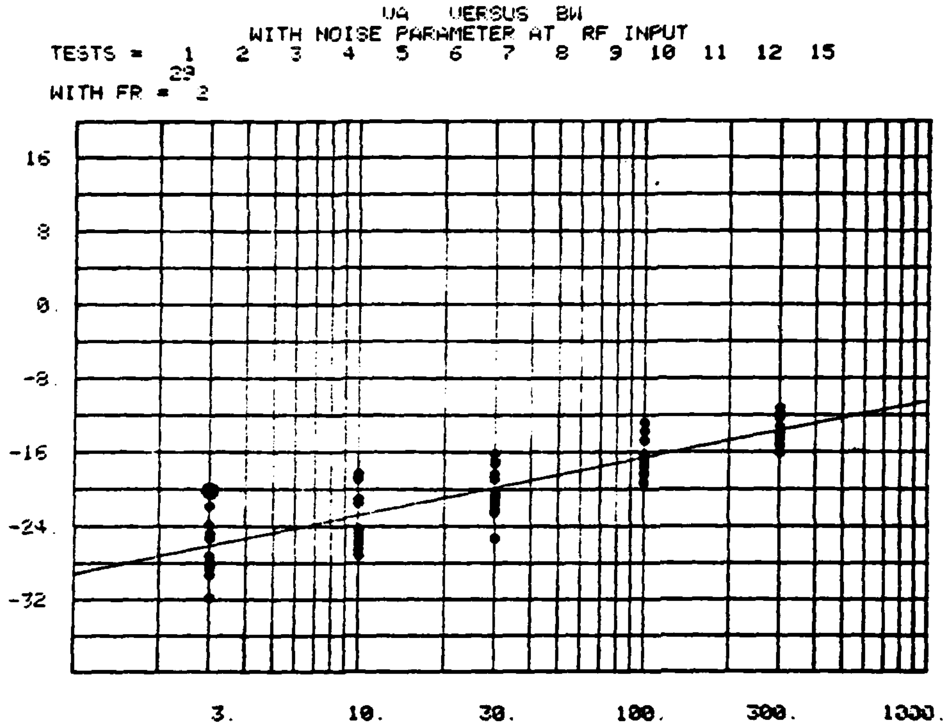

VT VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 2
16
8
0
-8
-16
-24
-32
3.
10.
30.
100.
300.
1000.

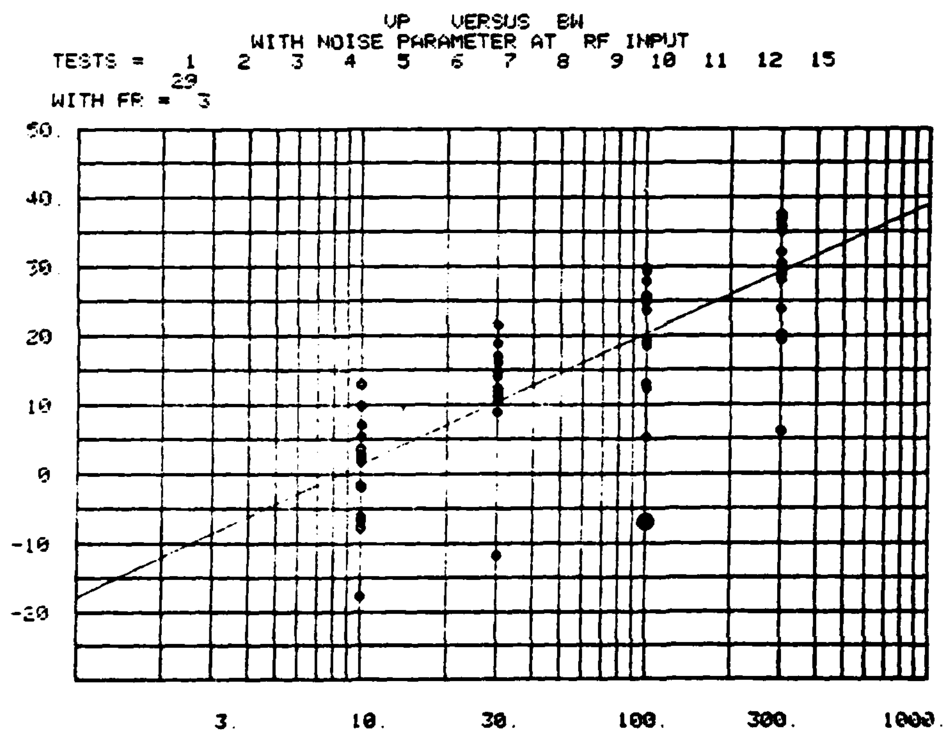
VV VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 2

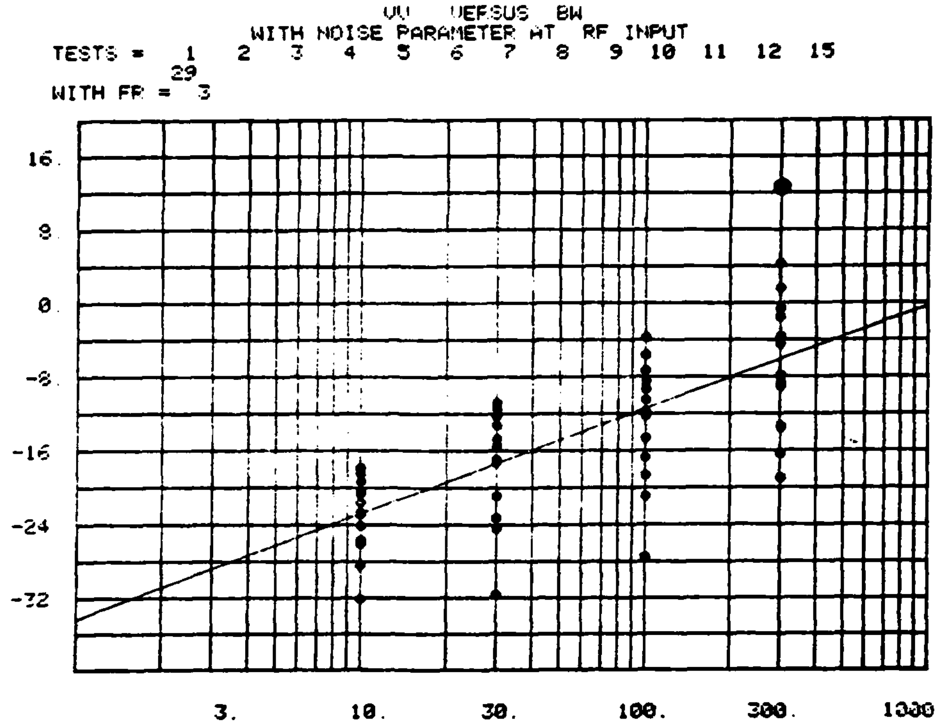


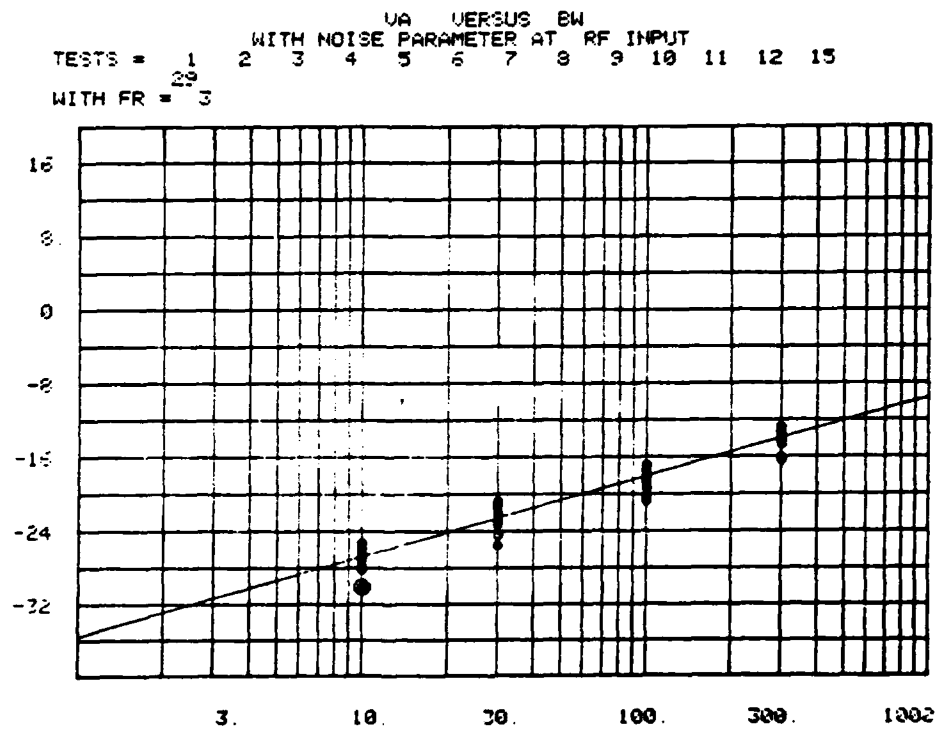
SA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 2



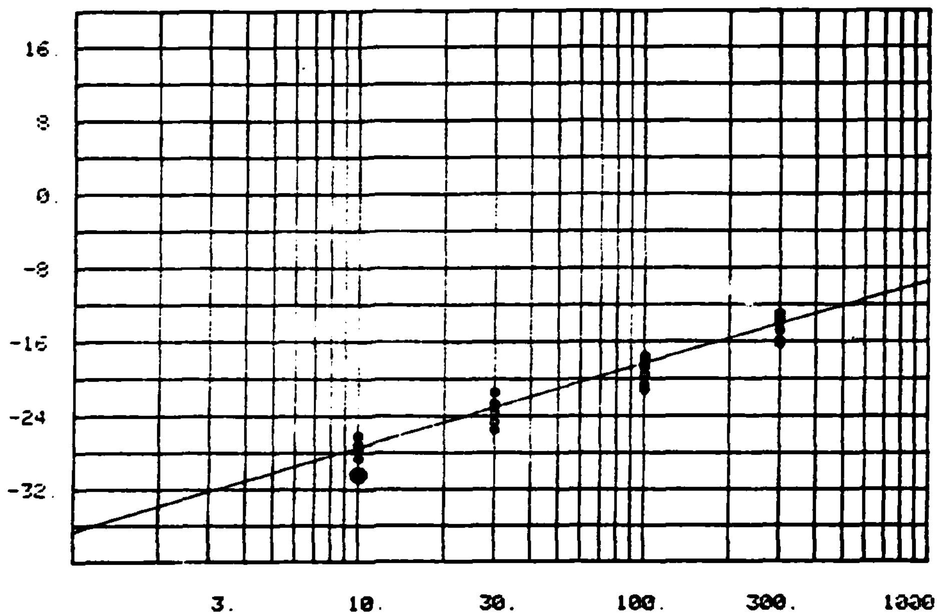

VA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 2
16
8
0.
-8.
-16
-24.
-32
3.
10.
30.
100.
300.
1000.


VP VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 3
50.
40.
30.
20
10
0
-10
-20
3.
10.
30.
100.
300.
1000.

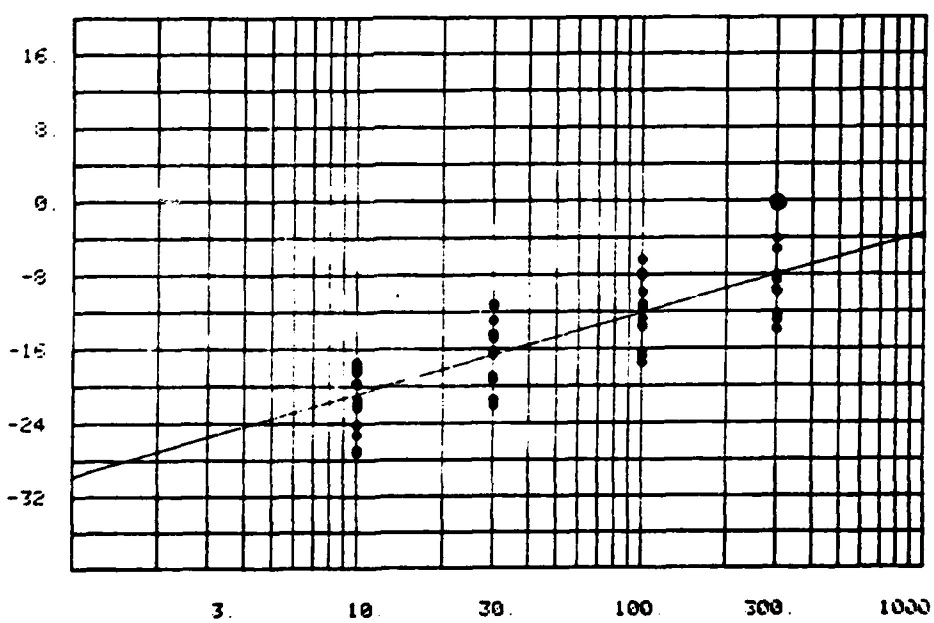

VV VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 3
16.
8.
0.
-8.
-16
-24
-32
3.
10.
30.
100.
300.
1000.

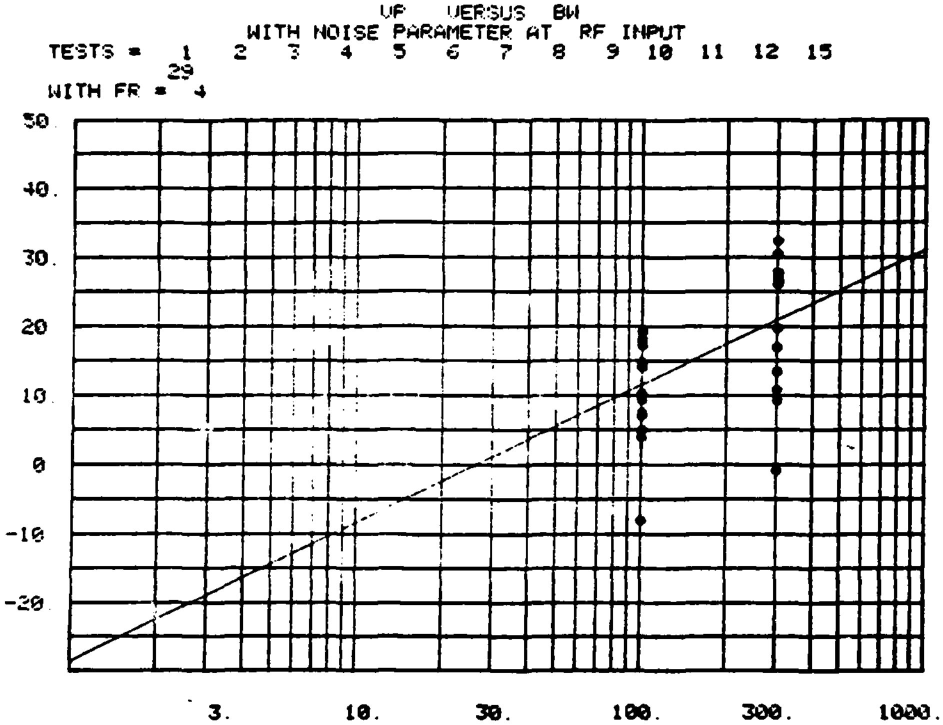

VA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 3
16
8.
0
-8
-16
-24
-32
3.
10.
30.
100.
300.
1000.

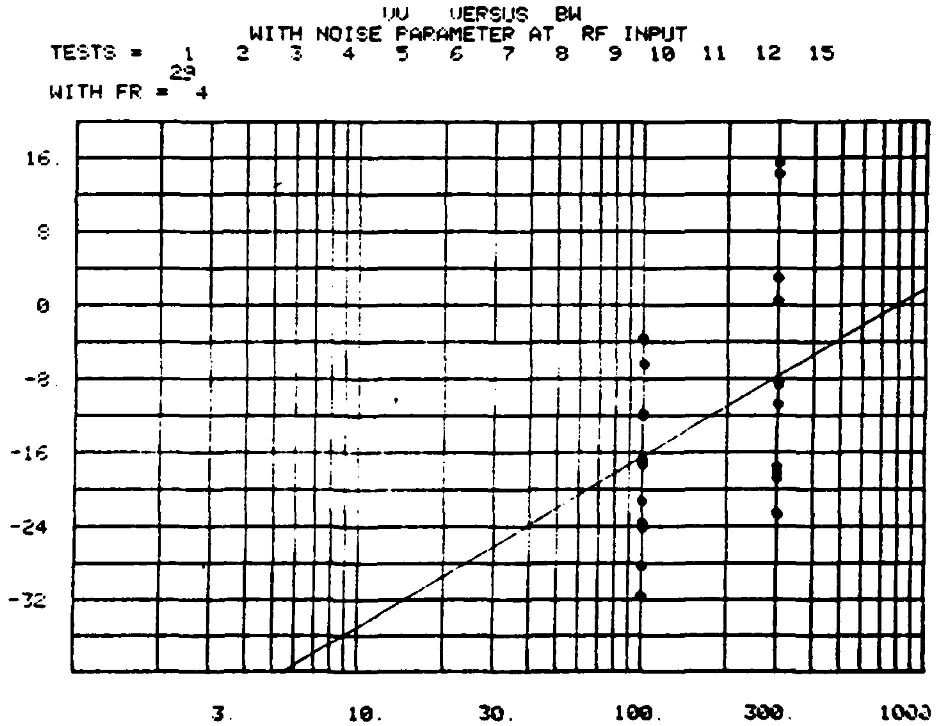
SA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 3

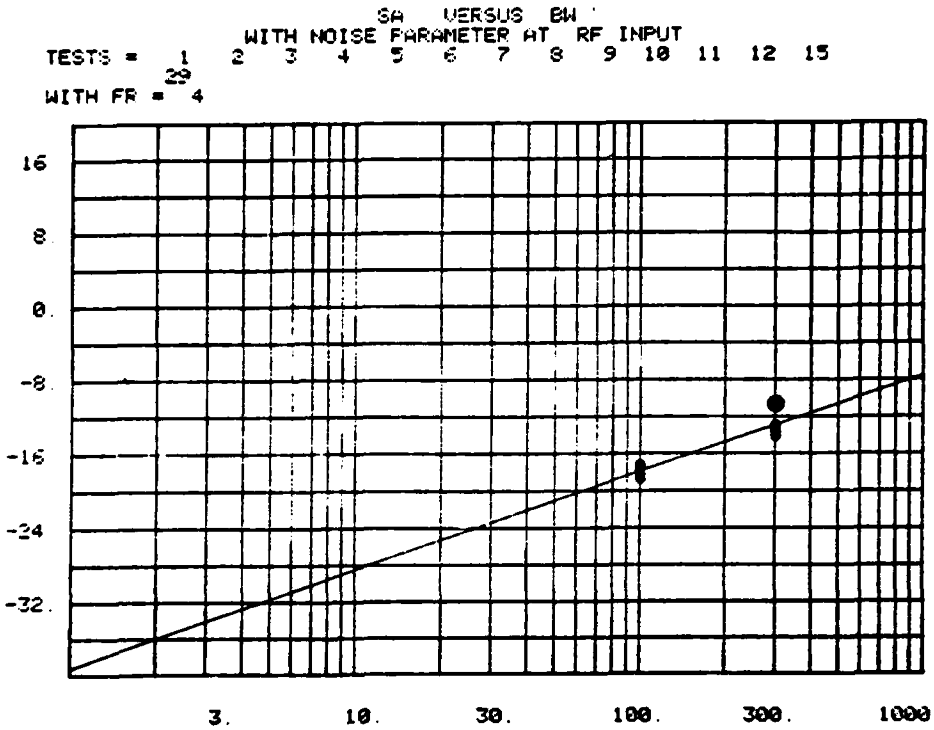


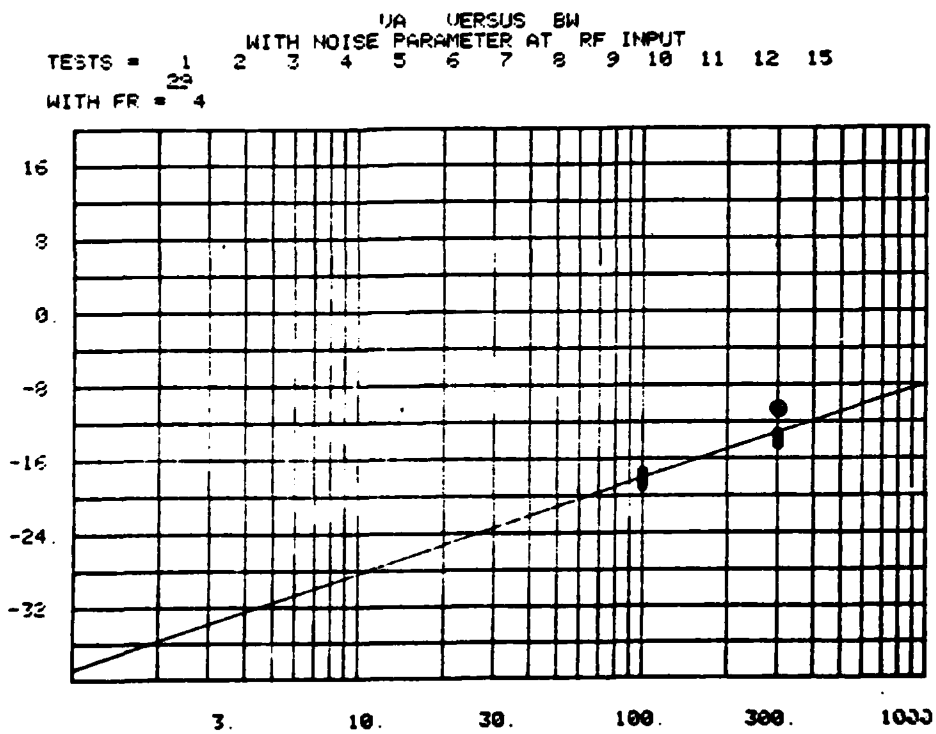
UT VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 3

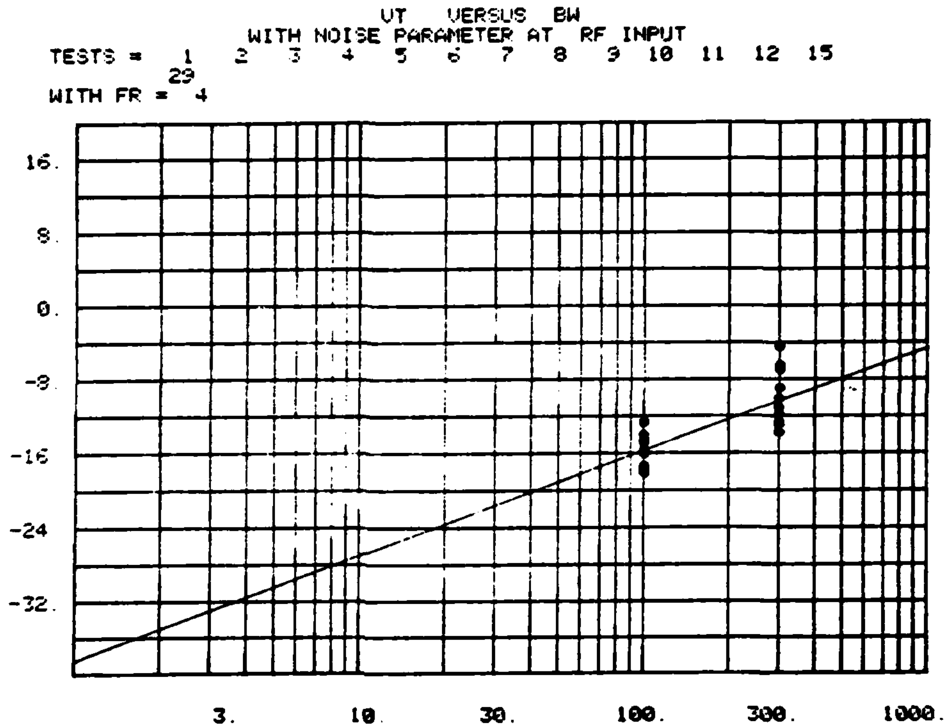



VP VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 4
50.
40.
30.
20
10.
0
-10
-20
3.
10.
30.
100.
300.
1000.


VU VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15 29
WITH FR = 4
16.
8
0
-8.
-16
-24
-32
3.
10.
30.
100.
300.
1000

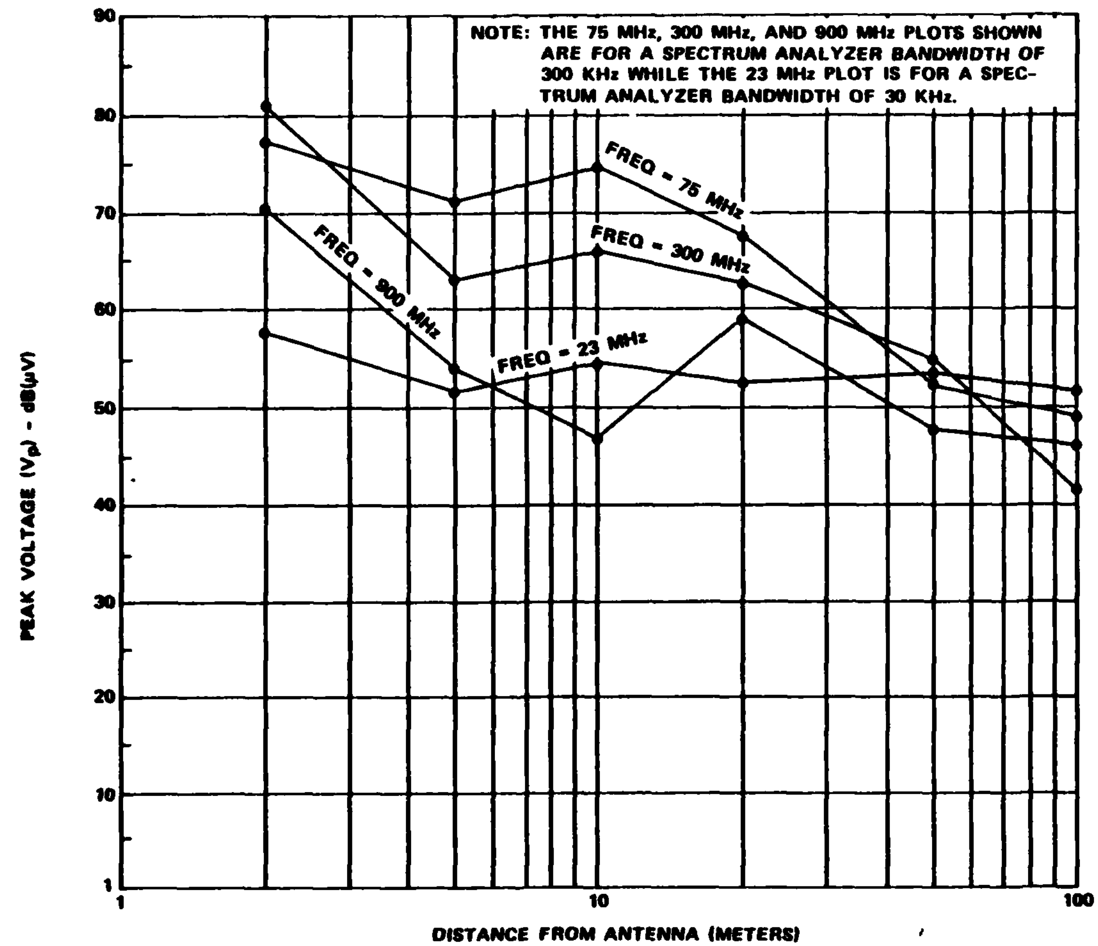

SA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 4
16
8.
0.
-8.
-16
-24
-32.
3.
10.
30.
100.
300.
1000


VA VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 4
16
8
0.
-8
-16
-24.
-32
3.
10.
30.
100.
300.
1000.

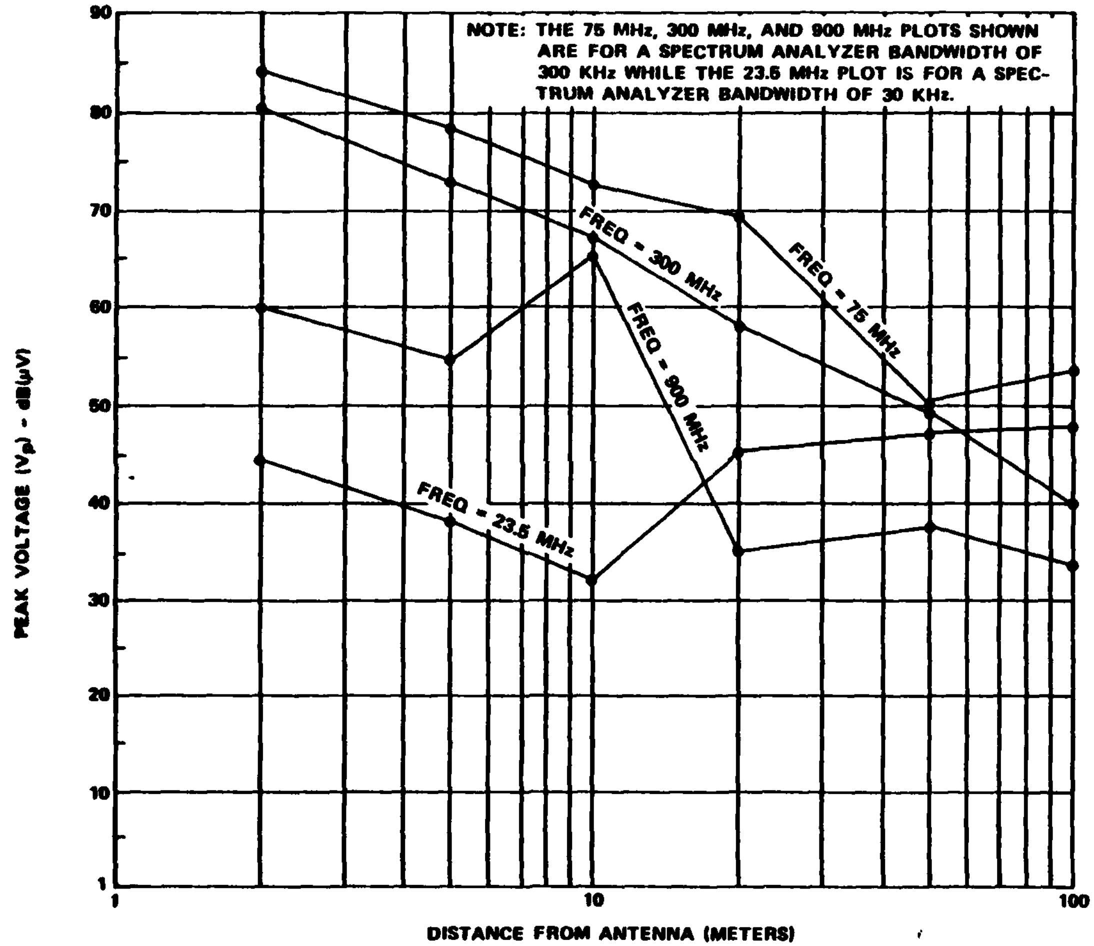


VT VERSUS BW
WITH NOISE PARAMETER AT RF INPUT
TESTS = 1 2 3 4 5 6 7 8 9 10 11 12 15
29
WITH FR = 4
16.
8.
0.
-8.
-16
-24
-32.
3.
10.
30.
100.
300.
1000.

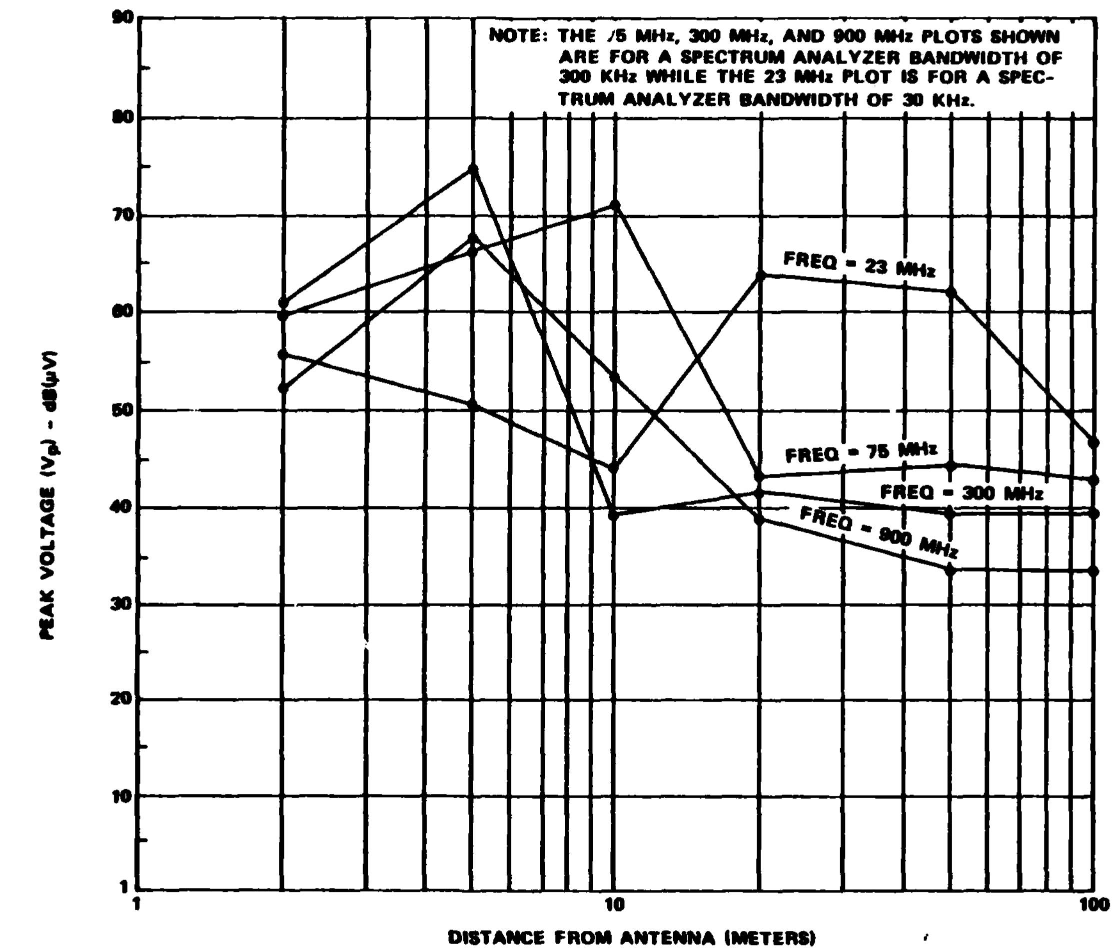
3.9 DATA PLOTS OF V_p AND V_{rms} VERSUS DISTANCE FOR SINGLE VEHICLES



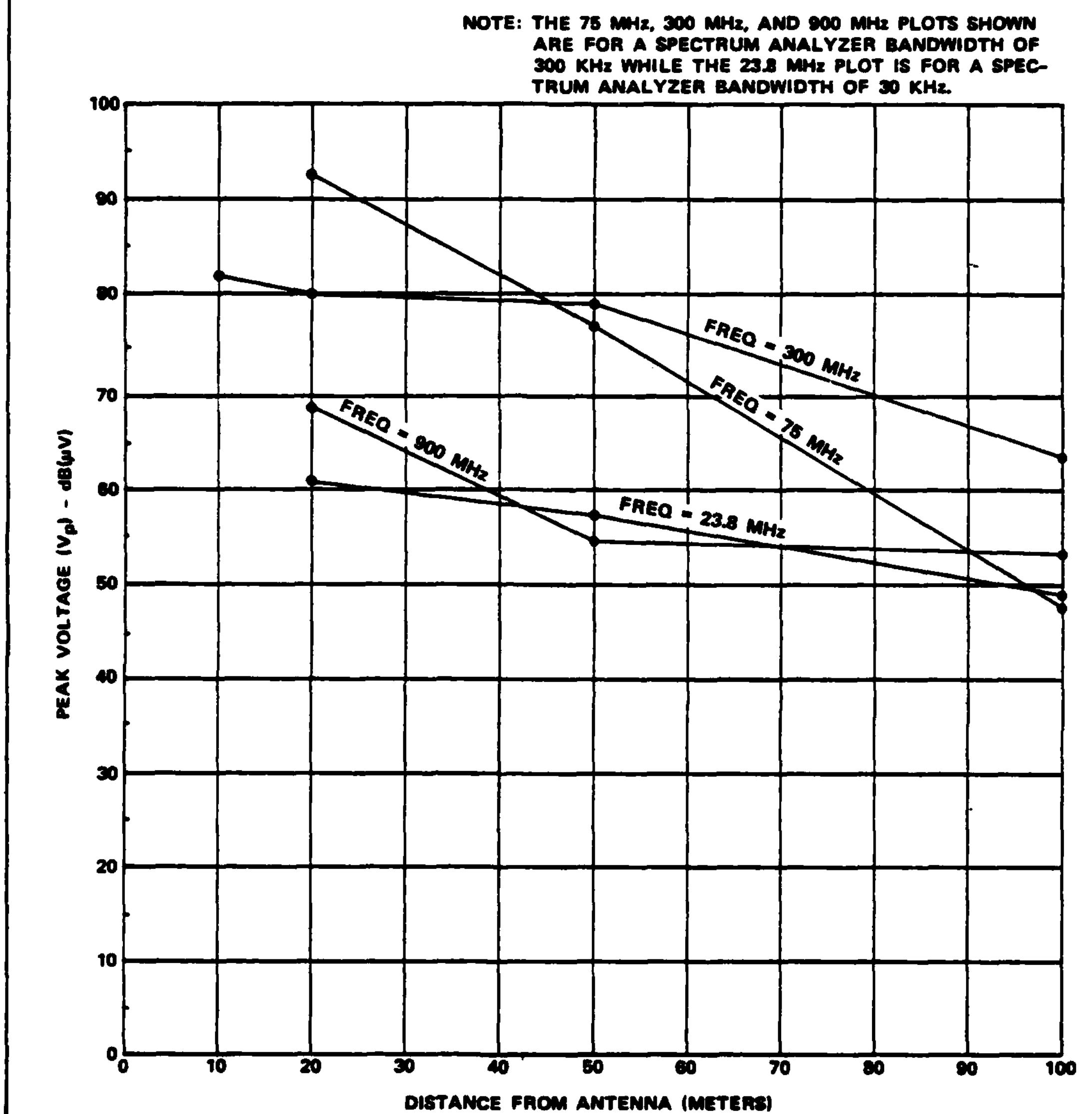
Measured peak voltage level of vehicular noise from Vehicle 1 versus antenna distance for various frequencies and bandwidths.



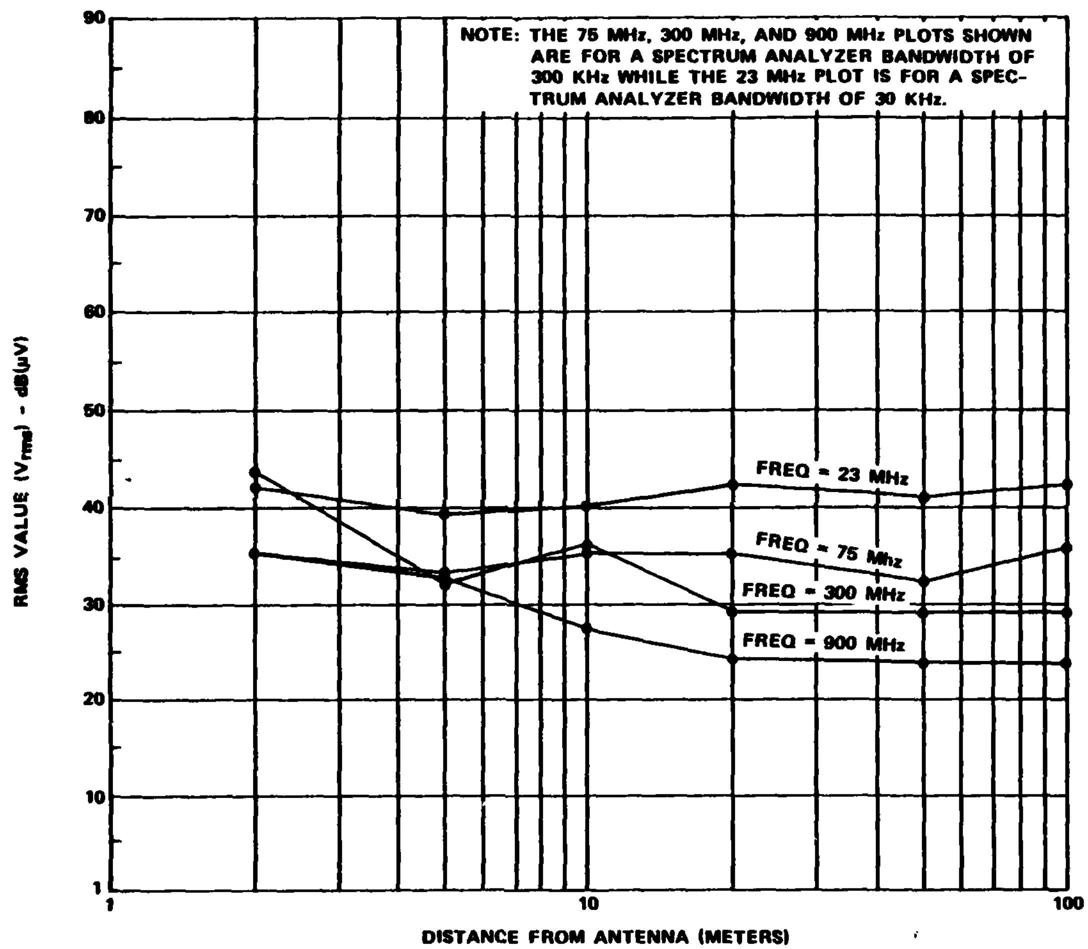
Measured peak voltage level of vehicular noise from Vehicle 9 versus antenna distance for various frequencies and bandwidths.



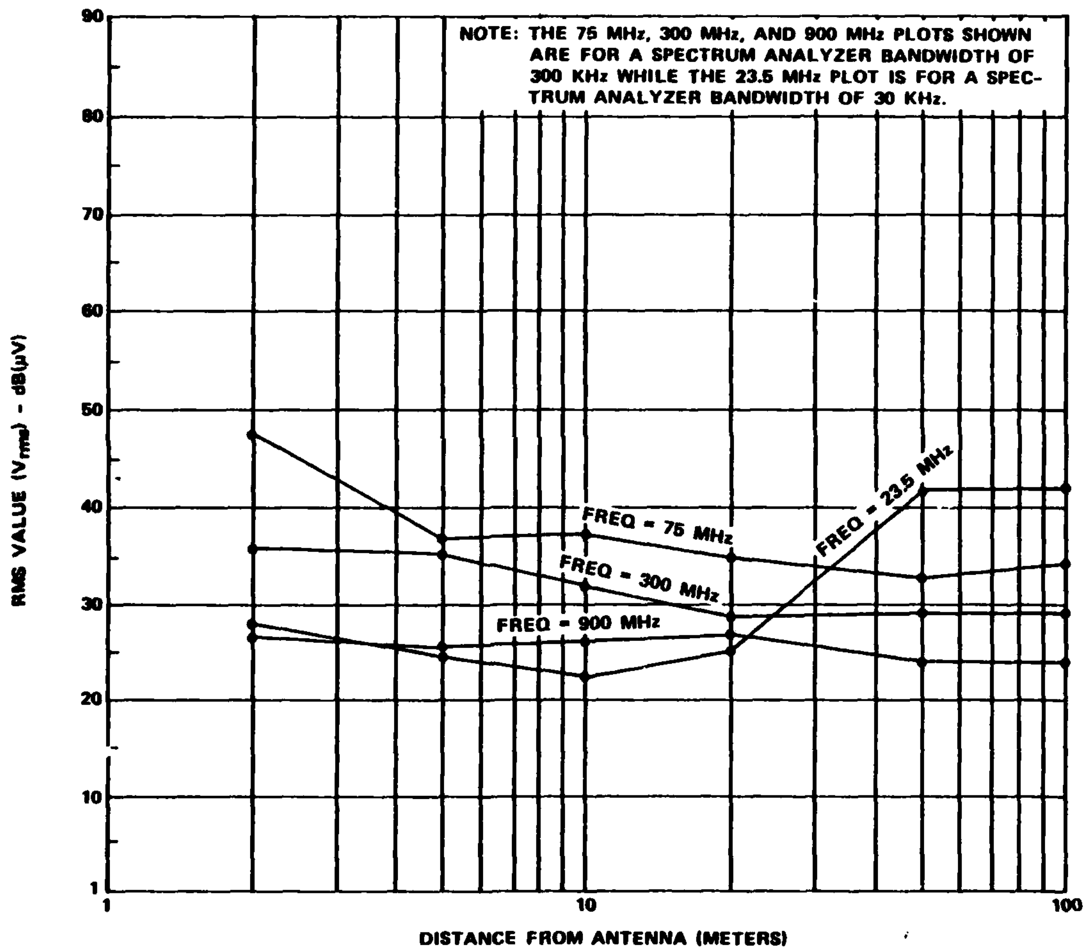
Measured peak voltage level of vehicular noise from Vehicle 12 versus antenna distance for various frequencies and bandwidths.



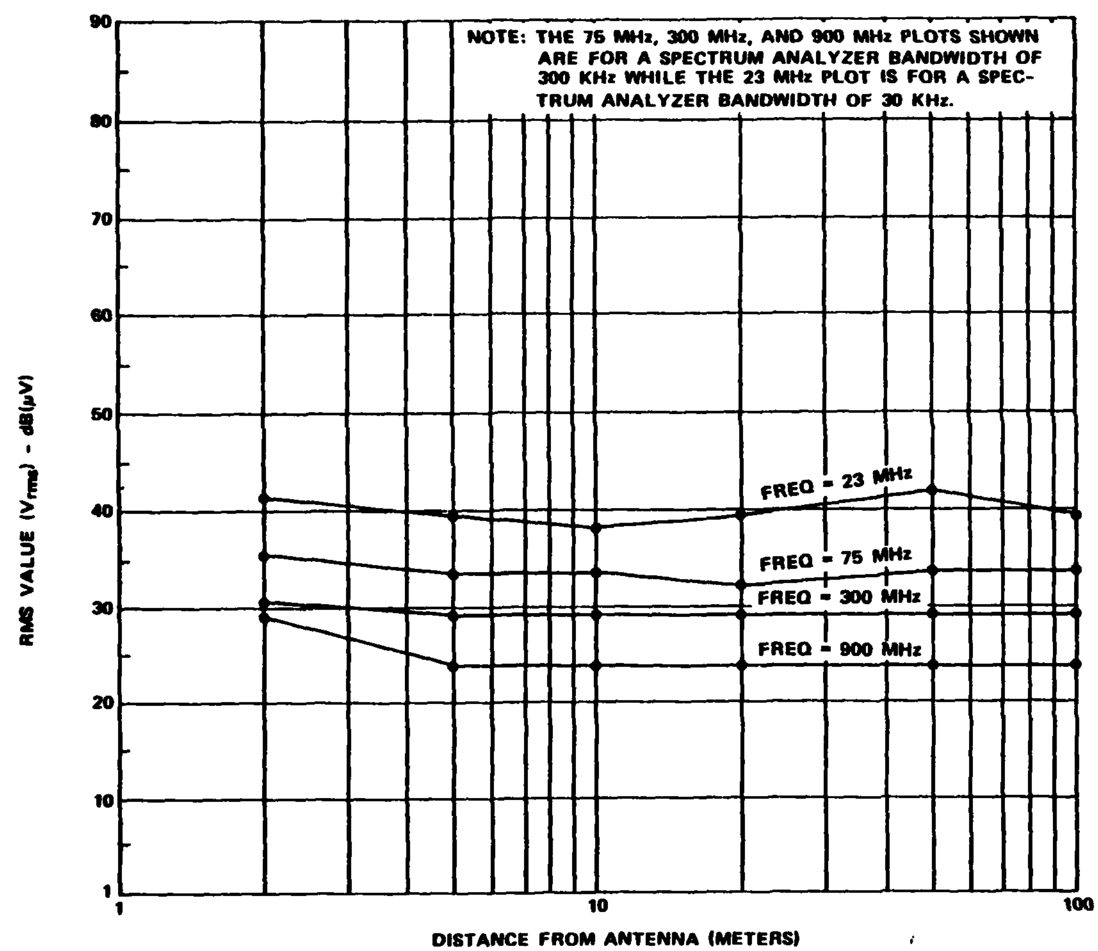
Measured peak voltage level of vehicular noise from the 1970 Chevrolet C-30 truck (Purdy's) for various frequencies and bandwidths.



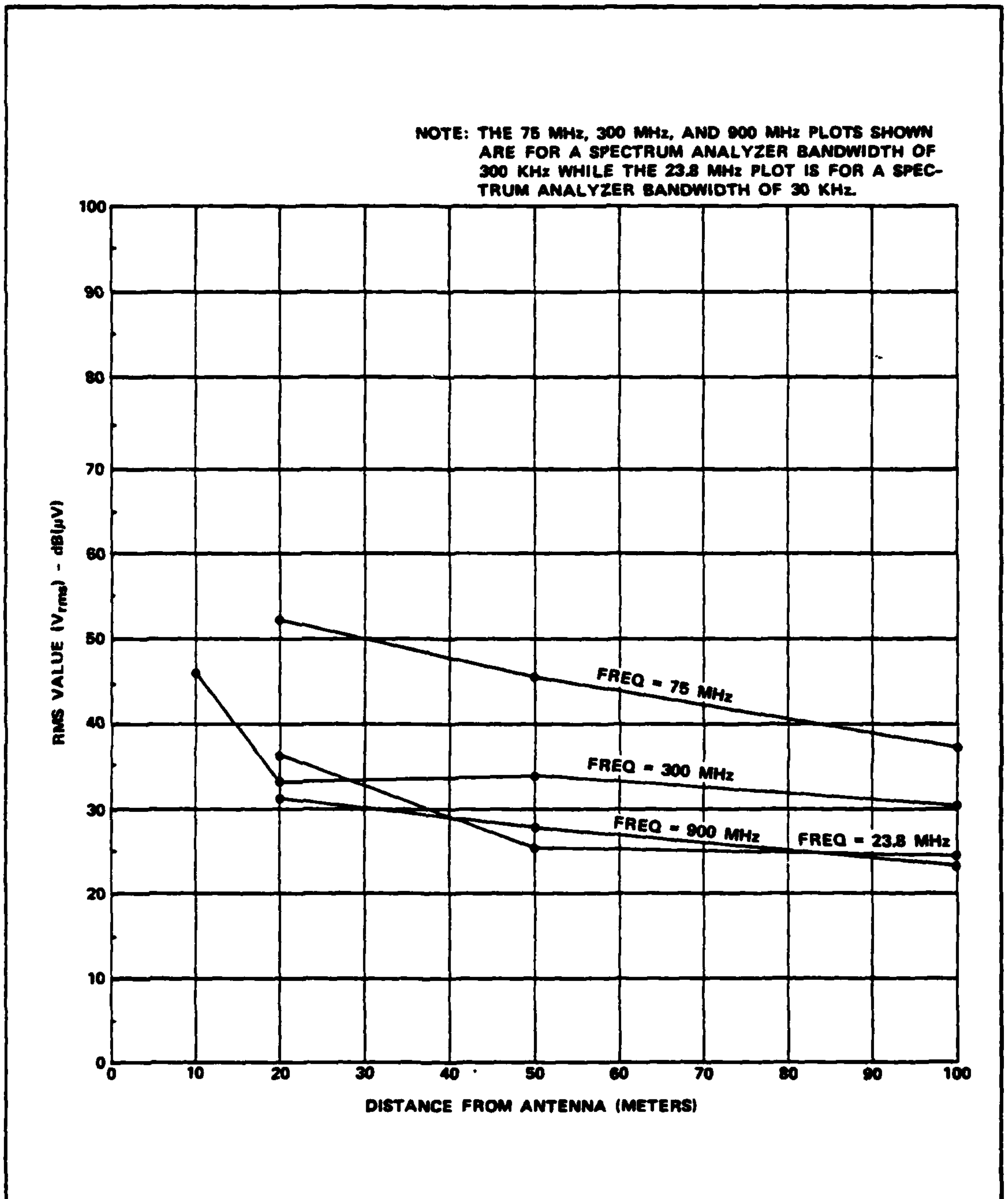
Measured rms value of vehicular noise from Vehicle 1 versus antenna distance for various frequencies and bandwidths.



Measured rms value of vehicular noise from Vehicle 9 versus antenna distance for various frequencies and bandwidths.



Measured rms value of vehicular noise from Vehicle 12 versus antenna distance for various frequencies and bandwidths.



Measured rms value of vehicular noise from the 1970 Chevrolet C-30 truck (Purdy's) for various frequencies and bandwidths.

APPENDIX 4 - GLOSSARY OF SYMBOLS

APD = Amplitude probability distribution function, plotted with envelope level in db(μV) or dB re rms as the ordinate and exceedance probability as the abscissa, with the probability axis scaled to be proportional to [-10 log (-ln P)]

a = Subscript used to indicate applicability to the ambient component

$E[\cdot]$ = Expected value of the variable specified

$\Gamma(\cdot)$ = Gamma function of the argument:

$$\Gamma(z) = \int_0^{\infty} x^{z-1} \exp [-x] \, dx$$

Γ'_B = Middleton's notation for σ_G^2/Ω_{2B}

IF = Intermediate frequency

i = Subscript used to indicate applicability of an envelope of probability value to vehicle i

K = 10 log k (i.e., k in logarithmic units)

k = "Intercept parameter" of the Weibull distribution

m = "Slope parameter" of the Weibull distribution

Ω_{2B} = Mean squared "impulsive" component at IF

ω_{IF} = IF radian frequency

P = IF envelope exceedance probability:

$$P(R_1) = \text{Prob} \quad [R \geq R_1]$$

P_I = Value of exceedance probability at the intersection of the vehicular and ambient component lines

P_N = IF envelope power in dBm

P_z = Value of P at the pivot point for multiple-vehicle predictions

$P_{6B}\{\cdot\}$ = Middleton's set of six parameters that are used in his Class B model

p = Weibull probability density function:

$$p(r) = \begin{cases} k\ m\ r^{m-1} \exp\left\{-kr^m\right\} & r \geq 0 \\ 0 & r < 0 \end{cases}$$

R = IF envelope level in dB(μV)

$$R_1 = 20 \log r_1$$

R_B = Value of R at the bend-over point in Middleton's Class B model

R_I = Value of R at the intersection of the vehicular and ambient lines

R_d = Value of R where, in Middleton's Class B mode, the amplitude distribution function starts to differ from a Rayleigh line

R_n = For $n < 1$: value of R at an exceedance probability of $P = n$

R_p = Value of R about which an ambient line is pivoted to a Rayleigh slope

R_{pv} = Value of R about which a vehicular line is pivoted

r = IF envelope level in μV, defined with $r \geq 0$

r(t) = IF envelope level as a function of time

S = Desired signal level at the RF input to a communication receiver. Units may be dBm or dB(μV), whichever is specified.

σ = Parameter of the Rayleigh distribution, related to the Weibull k parameter by $k = (2\sigma^2)^{-1}$ when the Weibull $m = 2$

σ_G^2 = Mean squared value of the Gaussian component at IF

V_a = rms ambient component in the IF envelope in dB(μV)

V_{av} = Average IF envelope value in dB(μV)

= $20 \log \left(E[r(t)]\right)$

V_d = Dispersion parameter = $V_{rms} - V_{av}$

V_p = Peak IF envelope value in dB(μV)

V_{rms} = rms IF envelope value in dB(μV)

= $20 \log \left(E[r^2(t)]\right)^{1/2}$

V_v	=	rms vehicular component in the IF envelope as estimated by the Weibull distribution, in dB(μV)
v	=	Subscript used to indicate applicability to the vehicular component
X	=	-10 log (-ln P)
X_I	=	Value of X at the intersection of the vehicular and ambient lines
X_p	=	Value of X about which an ambient line is pivoted to have a Rayleigh slope
X_{pv}	=	Value of X about which a vehicular line is pivoted
z	=	An estimated value of r for the multiple-vehicle case

ME

8